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HUGO GERNSBACK, Editor

Science-Fiction **PLUS**

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Cosmatomic Flyer

Exploration of Mars

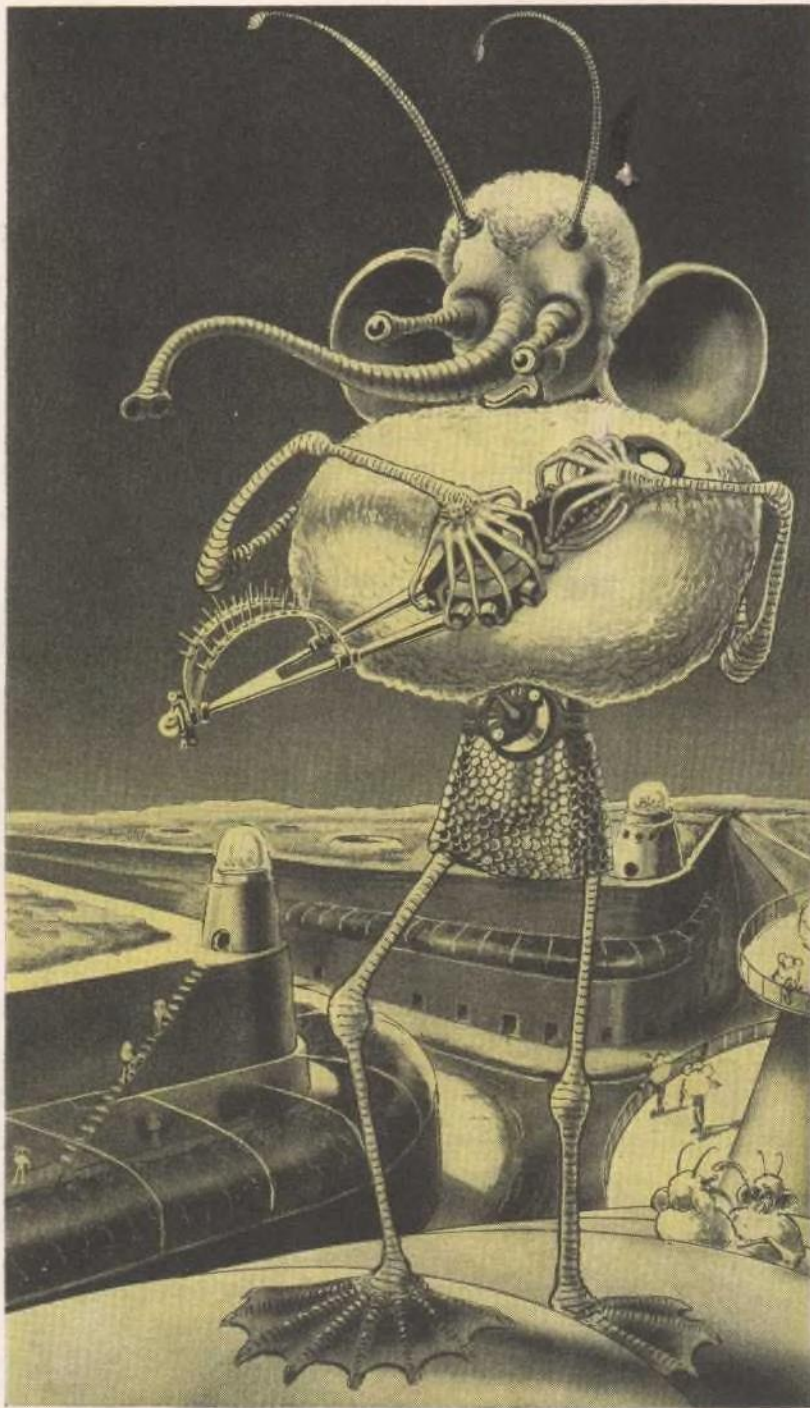
by HUGO GERNSBACH

(Illustrations by Frank R. Paul)

If there is one outside world about which we know a great deal, it certainly is the planet Mars. Astronomers for ages have closely scrutinized our neighbor, while scientists today agree that the red planet is far advanced in its evolution. A dying world—its probable civilization is many hundreds of millions of years in advance of ours.

What can we expect of such enlightened civilization, its culture, its progress? How do they build their canals? How does a dying world feed its teeming billions? How and where do Martians live? What type of transportation do they use? If Martians are so far advanced, why don't they visit us?

These and dozens of other burning questions that have puzzled us for years are lucidly explained—often most convincingly—by the author-scientist of this absorbing story.



Male Martian. He is over 10 feet tall.



Grego Bانشuck,
Explorer



"The study of Mars proves that planet to occupy earthwise the post of prophet . . . For it is by way of foretelling our future."

—Professor Percival Lowell in his book, "Mars as the Abode of Life."

FAS First to Explore Mars

October 10, 1949, may well be referred to by historians as the most important date of the twentieth century! On that memorable day, at 4:56 p.m. Mountain Standard *Earth* Time, the intrepid explorer, Grego Bانشuck, landed his atom-powered space flyer on Mars, the fourth planet of the solar system.

For obvious security reasons, I have only now been permitted to tell the full facts to the world.

Financed by FAS, the Federation of American Scientists, the world-famed physicist-inventor, atomic pioneer, and explorer had labored for more than a year on his space flyer in the lonely fastness of Nevada's Ralston Desert. Here a crew of 22 FAS physicists and college professors toiled valiantly and efficiently in five air-conditioned Quonset huts. These huts, stocked with food, tools, machine shop, and a thousand other items, also were the living quarters for the secrecy-sworn band of atomic space pioneers.

All supplies, material, food, etc., were flown in with special helicopters of the U.S. Air Force by hand-picked personnel. While the entire cost of the project was financed by FAS, the U.S. Government lent its complete support, recognizing the great importance of the historic undertaking.

The Space Flyer

Arrangements made early in 1948 provided that, if the new and revolutionary space flyer were successful, the U.S. Department of Defense then would take over the building of all further Bانشuck space machines. In turn, the U.S. would supply the precious atomic fuel.

For security reasons I am not permitted to state how the Bانشuck atomic flyer operates, nor what the exact fuel consists of. Only a most sketchy description is therefore possible:

The historic space machine, christened MARS I, was blimp-shaped—its smooth outside surface broken only slightly by three fan-shaped ejection vents and the radar antennas.

Except for 24 two-inch thick quartz porthole windows, the MARS I was constructed entirely of tempered titamagnesium 4. It measured 65 feet long by 12 feet in diameter. Its total weight, including its six-man crew, was approximately 52 tons.

Without question, Grego Bانشuck's greatest contribution to interplanetary space-flight is his brilliant atom-negative gravitator. He realized years ago that purely rocket-powered space ships would never be practical because of the tremendous amount of fuel required to free the ship from terrestrial gravitation at the start of the trip. Once out in space—after the first 10,000 miles—rocket propulsion is comparatively simple.

Dr. Bانشuck is the first to have overcome the problem, which has baffled astro-engineers for decades, of developing the concentration of energy necessary for a successful launching into space beyond the earth's gravitational pull.

Atom-Negative Gravitator

Using Dr. Einstein's famed equation, $E = mc^2$ —which made the release of atomic energy possible—Bانشuck after long experiments succeeded in discovering the principle of his atom-negative gravitator.

Einstein's $E = mc^2$ simply means that the energy contained in any particle of matter is equal to the mass of the body in grams, multiplied by the square of the velocity of light. Bانشuck kept his eye on that mass, because mass is intimately linked with gravitation, as any bright schoolboy knows.

For the layman better to understand Einstein's equation, it can be translated as follows: Take 2 pounds of coal and convert it *entirely* into energy. This conversion will yield over 25 billion kilowatt hours of electric current—more than all the electric power plants in U.S. can generate in 60 days, running day and night without stopping.

But Einstein also proved long ago that *energy has mass*! Dr. Bانشuck therefore simply juggled Einstein's $E = mc^2$ equation in such a manner that *his atomic generator constantly transforms energy into mass*. If a sphere (the space ship) generates and expels a constant stream of mass at great speed, a tremendous reaction is given to the sphere. Imagine a 10-inch cannon firing, at great speed, a projectile weighing as much as the Empire State Building. The resulting back-kick of the gun would be titanic.

Mass-Ejection Propulsion

Bانشuck's principle of *mass ejection* at high speed cannot be compared even remotely with a rocket which uses only hot gases, and is therefore ludicrous by comparison. Rocket propulsion compared to the atom-negative gravitator is of the order of one million to one in efficiency.

Moreover, in all past-projected space rockets, the weight of the fuel alone was nine-tenths that of the entire ship! In Bانشuck's atomic space flyer, it is less than one-hundredth! Furthermore the acceleration at the start of the flight can be gradual, the speed of the flyer increasing immeasurably after it has left the earth's atmosphere behind.

The curious action of *mass ejection* is that the small particles ejected are by no means red hot and incandescent—as is rocket gas. They are pellets about the size of buckshot, EACH PELLETT WEIGHING SEVERAL HUNDRED TONS, but only at the moment of ejection. Moreover, these pellets are solid for less than one-thousandth of a second. After that their mass disintegrates into nonradioactive radiation.

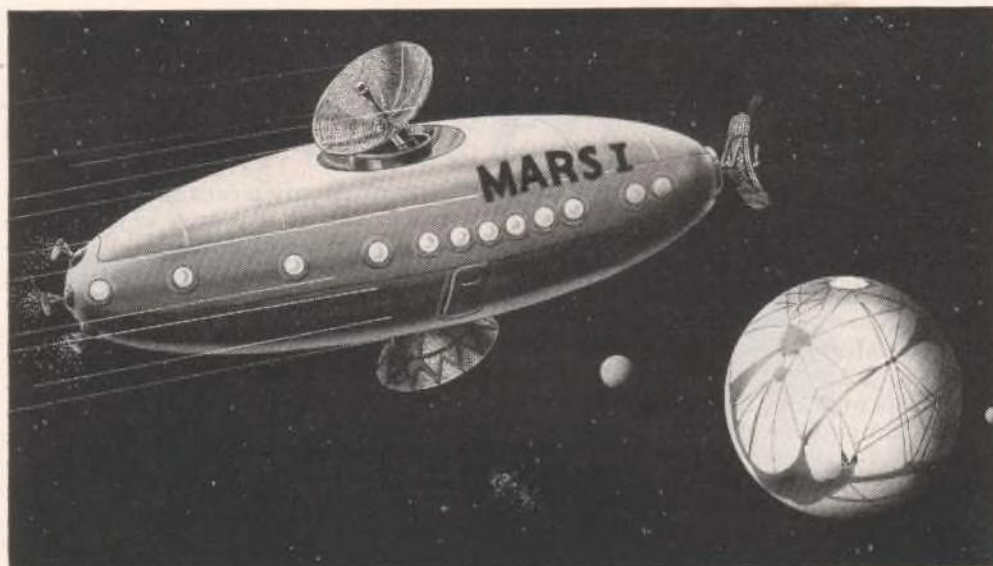
In short, Dr. Bانشuck's generator converts energy into mass in chain-reaction fashion. In a sense, it is an atomic bomb in reverse! At the same time, it resembles an atomic pile, because, as in the latter, energy can be collected and controlled as wanted.

The Historic Flight to Mars

A number of trial flights were made with the space flyer MARS I early in 1949. The first, extending only into the stratosphere, was made to test the atomic plant and the air-worthiness of the flyer.

The second flight went 200 miles above the earth's surface. The interior of the flyer was pressurized at 6,000 feet above the earth, which was also the pressure maintained on the first interplanetary trip.

The third and last trial flight was at an altitude of 1,100 miles in the vacuum of space at an average outside temperature of 260 degrees below zero. The earth was circumnavigated twice, approximately over the equator. The first circumnavigation at a speed of



Atomic Space Flyer: Uses an entirely new principle—Mass Ejection Propulsion instead of inefficient rocket principle. Atomic generator transforms energy into mass which propels flyer. Note three radar antennas which automatically steer ship to avoid meteorite collisions. At lower right Mars with canal network and its 2 moons: Phobos and Deimos.

4 miles a second (14,400 miles an hour) took 2 hours and 10 minutes. The second trip at 6 miles a second (21,600 miles an hour) took 1 hour and 27 minutes to circle the earth.

The Great Day

Finally on August 22 came the great day of departure. Grego Banshuck had selected for his crew and companions the five well-known physicists Kars Gugenchob, Gus N. Habergock, Oskar C. Henbugg, Grace G. Hucksnoh, and Erno Shuckbagg.

The day of departure had no particular astronomical significance. On that date Mars was 170 million miles distant from the earth. This distance would decrease daily till on March 24, 1950, Mars would be in opposition with the earth at 60 million miles—not the closest opposition, which will take place on September 11, 1956, when Mars will be only 35 million miles distant.

The final take-off at 11:15:15 was uneventful and practically noiseless, if compared with a large rocket take-off. Like all previous flights, the final one took place at night to avoid observation by outsiders.

Then the men who remained behind took over to record the historic flight by radio and radar. The powerful desert station could keep in touch by radio communication with the flyer's crew 24 hours a day, and for 14 hours daily by radar (due to the earth's revolution).

Meteoroid Collision

The trip at the maximum speed of 40 miles per second was calculated to take about 49.2 days after leaving the earth.* This was exceeded by only one day, because of a small mishap.

Six days out, a tiny meteoroid, about the size of a pea, collided with MARS I and penetrated the inch-thick metal shell of the space flyer. Traveling at a rate of about 42 miles a second—a speed far greater than that of any high-power rifle bullet—the tiny missile damaged a B-reactor of the atomic power plant. The thick rubber layers on the inside of the flyer's shell effectively stopped any air loss until final repairs to the shell were made. But it took almost a day to repair the reactor itself.

An elaborate radar system automatically veers the space ship to prevent meteorite collision; but evi-

dently the meteorite shower was so dense at the time that one small fragment struck the ship.*

Finally on October 9 there was sent the last laconic message out of the recesses of the great void:

"Will land on Mars tomorrow 2 p.m. Mountain Standard Earth time, near Syrtis Major."

GREGO BANSHUCK

The Landing on Mars

(Dr. Grego Banshuck, first human to set foot on Mars, now personally relates—exclusively for this magazine—his historic experiences on the Red Planet. Due to space limitations, only the highlights are presented here. Full details of the entire exploration trip will be published soon in a special book authored by Banshuck and his five fellow explorers.)

The MARS I touched ground on the fourth planet at 2 p.m. Mountain Standard Earth Time, on October 10, 1949. Yet, 15 hours before landing, we had unmistakably felt the influence of a superior force, which kept increasing as we neared Mars.

All six of us felt simultaneously a sensation almost mind-numbing. We worked as if in a dream—mechanically, more by instinct than consciously. The tele-hypnotic force—for such it proved to be—increased constantly. We could talk to each other only with difficulty, and felt compelled to do things as if controlled by some superior will.

We still steered a course—now at reduced speed—to effect a landing south of the great triangular configuration Syrtis Major, shown prominently above the equator on all astronomical maps of Mars. A few hours before landing, however, a clear and unmistakable order filled our consciousness:

* Hugo Gernsback, writing in an editorial article, "Radar Possibilities," in RADIO-CRAFT, May, 1945, was the first to point out the great possibilities of radar for safeguarding rockets in interplanetary flights.



Weight of man: on Earth and his comparative light weight on Mars.

* A speed of 40 miles per second in free space is moderate. Meteorites travel up to 43 miles per second before striking the earth's atmosphere.

Hypno-Telepathic Command

"Land your machine on triangular plain near apex Syrtis Major. Do not leave machine till ordered."

This hypno-telepathic command, repeated three times, was recorded by all of us simultaneously.

We steered for the large, red triangular plain as ordered, making an uneventful landing at 2:04:16 p.m.

Through the portholes we noted the brilliant, but now much smaller, sun in a dark-blue, almost black, sky. This we had anticipated, as the atmosphere on Mars is very tenuous and can best be compared with the upper reaches of our own stratosphere. It is so thin that no human being could live in it very long. We noted strange markings on the vermilion-red ground, which we could naturally not interpret. We also saw weird flying machines—round, transparent and cheeseboxlike, with no visible means of propulsion.

On the horizon were huge shining structures which seemed to move.

Suddenly five of the flying cheeseboxes descended upon us and surrounded our MARS I. They stationed themselves about 20 feet above our space flyer, forming a complete circle around us. Soon we were told telepathically: "Remain inactive while sanitation process takes place."

Hot Quarantine

Instantly every metal object gave out long electric streamers; nonmetal objects—our bodies included—glowed with an unearthly, vivid green luminiference that burned and itched. Our whole insides tingled intolerably. Our temperatures were soon at a high fever—we were burning up. All of us lost consciousness. How long we remained in that state, and what happened while we were unconscious, none of us knows.

However, we awoke with a start, entirely normal again and imbued with an extraordinary sense of well-being. We were soon told that we could now leave our machine.

We equipped ourselves with our plastic, airtight, spherical helmets, strapped on our oxygen back tanks, put on warm suits, and unbolted the sealed door of our flyer in which we had lived for the past fifty days.

We stepped out carefully and gingerly, insecure with our now greatly lightened bodies. On earth our average weight per person was 150 lbs.; on Mars—due to its greatly reduced gravitation—we weighed only about 53 lbs. now.

Immediately we felt the cold in the thin air and knew that the afternoon Martian temperature was far below freezing.

But we had not been prepared for the sight of the Martians themselves, three of whom now rapidly strode over to us.

No one could have imagined the grotesque appearance of this race.

Behold the Martians

Almost 10 feet tall, their huge barrel-shaped upper bodies were surmounted by a tremendously ponderous head, shell-like ears almost a foot across, and—most surprising of all—an elephantine nose 3 feet long. Yet most impressive of all were the stalk-eyes which projected out of their heads and could telescope in or out. The huge eyes themselves were hypnotic in the extreme to us—we could never avoid their compelling gaze.

From the top of the head sprang two huge insect-like antennae—the telepathic organs. The mouth was like a flattened beak.

The entire body was covered by a wool-like growth for warmth. The arms and legs appeared thin and fragile. There were eight fingers on each hand, while their feet were huge webbed pads.

Later we understood the strange Martian physiques better. The race is very old—with over 2 billion years of evolution behind it. Due to the poor gravitational force of Mars, its atmosphere never had been dense. To survive, the Martians had to develop huge lungs; hence the enormous chest, dominating the entire body.

(On earth the Cholos Indians, living at an altitude of 12,000 feet in the Andes of Peru, have developed chests much larger than those of other humans.—Editor)

The huge ears were evolved because the thin Martian air conducts sound very poorly. Scents and odors, also travel poorly in the attenuated atmosphere, hence the long, elephantine nose *which must go to the odor*, rather than have the odor go to it.

As arms and legs have performed little physical work for over a billion and a half years, they have gradually atrophied, becoming thinner and thinner. The huge feet are necessary due to Mars' inferior gravitation. It would be difficult for the 10-foot Martians to walk with small feet—the large pads give them a secure footing. The low gravitation also accounts for the great bodily height of the Martians.

The stalklike, mobile eyes make for superior focusing and excellent eye accommodation. Martians need no glasses; indeed the telescoping eyes act like two precision bellows cameras.

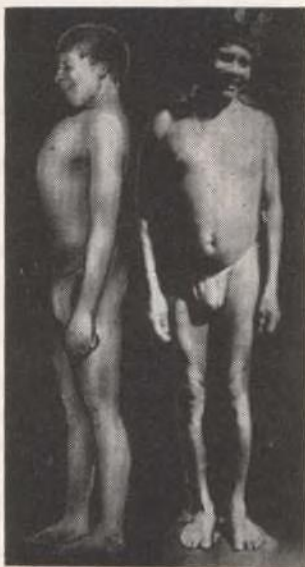
Telepathic Antennas

Most interesting of all are the telepathic antennas. They appeared first about a billion years ago, when the brain had already enlarged to twice the size of the prehistoric Martian's. The present-day Martian has a colossal brain which in volume is about $9\frac{1}{2}$ times that of the human.

By now the three Martians had advanced up to us and stood eyeing us as if we were some newly arrived puppies. There seemed to be a good-natured smile on their superintelligent countenances, but no surprise or curiosity whatsoever.

That they seemed to know all about our thoughts, and indeed all about us as well as our plans, became quickly apparent. The leader, a majestic figure, and compelling in the extreme, was distinguished physically solely by a wide sort of armband on his upper arm. It had a number of scintillating spots which changed continuously in color in a strange rhythm. His two companions stood a little to one side and were rapidly working some hand instruments attached to the wrist (thought-recorders—we found out later).

The leader now addressed us telepathically. While he talked, his antennae waved from side to side constantly. From time to time he moved his



Cholos Indian



PHOTO FLAGSTAFF OBSERVATORY, FLAGSTAFF, ARIZ.

Mars Canals: Mars, the fourth planet is much smaller than the Earth. The latter is 7918 miles in diameter. Mars only 4216 miles. Above we see one side of the Martian sphere, criss-crossed in all directions by the vast network of canals. These canals are real—they have been photographed repeatedly. The above picture was made when Mars was 47 million miles distant from the earth. It never comes closer than 35 million miles. Note the two ice caps at top and bottom, the top is south, the bottom north (as seen through telescope). As the ice of polar cap melts (see page 11), the waters flow into the canals equatorward. Some of the canals are over 3300 miles long. All canals are geometrically straight. They run right through the dark areas which indicate land with vegetation. Note black dots where canals meet at junctions.

head slightly for emphasis. The stalk eyes fixedly gazed at my own.

Electronic Disinfection

As "secretary" of the Mars Government he briefly welcomed us, stating that our coming was well known long before we left the Earth. He stated that the Health Authority required our brief quarantine detention in our space flyer, in order to exterminate electronically all disease-bearing bacteria and infection carriers.

He went on to say that he would communicate Martian thoughts to us in such a manner that we could understand, as far as this was possible, their civilization, their customs, and their mode of life. He warned us that we would be able to understand only very little and that most of what we saw would be forever unintelligible to us, due to the great evolutionary gulf that separates us.

He would be our steady companion for our entire stay on Mars and would try to answer all our questions, as far as he was able.

Flying Cheeseboxes

As he finished talking, one of the flying, round cheeseboxes settled down near us. Perfectly circular, it was completely transparent except for the center portion. About 40 feet in diameter and 15 feet thick, it had only two slight projections and no visible propellers or engine. As we approached the flying box, a round doorlike opening materialized in the side and we all walked in. Transparent seating arrangements were set all around the inside curved wall. The individual seats could swivel around completely so one could look out over the countryside. In addition, the seats automatically hugged your body as soon as you sat down.

In the center of the machine there was a small 5-foot black object, obviously the engine that drove

the flyer. Several questions to our leader confirmed this.

"Machine flies by neutro-gravitation," was the laconic answer. "Engine neutralizes gravity of ship, which then rises by invisible electromagnetic repeller of wavebeam. By changing angle of beam, ship travels in any horizontal direction."

"Who runs it?" was our next question. "I do," was the surprising answer, "by telepathic impulses! I merely concentrate my attention on the telepatho-amplifier which translates the impulses to steering device. Machine does the rest."

We all looked amazed. More and more we began to feel like six not-too-intelligent puppies set down in the control room of the Palomar Observatory, trying to investigate the mysteries of the 200-inch telescope!

The Earthlings—Our Arrival Causes No Stir

During our rapid trip to our quarters, we learned



Cosmotronic Microtelesonator Operator

from our host that our landing on Mars had been anticipated ever since our first test flight of MARS I. It must be remembered that a civilization over 2 billion years old is so much more advanced than ours, that little which occurs on Earth—or for that matter anywhere in the universe—is hidden from the Martian supertechnicians and scientists.

Their instrumentation has reached such advanced stages, such perfection and refinement, that I will give only a few examples to show what they have achieved in several spheres.

Their *cosmotronic* ultra-telescope can pick up any spot on earth and photograph it. I was shown *cosmographs*—faultless pictures of King Solomon, Moses on Mount Sinai, Cleopatra, Alexander the Great, and President Truman—all shots taken directly from Mars.

Their *cosmotronic* microtelesonators can pick up with a radarlike machine actual sounds from any spot on Earth and make a noise-free recording. As cosmic waves penetrate steel and granite for many miles, they have little difficulty in penetrating into our homes and skyscrapers, recording sound and sight. Later I was to see actual duplicates of one of our latest motion pictures taken directly from Mars as the picture was unreel at Radio City Music Hall in New York City! Such pictures (called *cosmographs*) of people walking on Earth cannot, of course, be made when Mars is directly overhead. The Martians take their pictures when the spot they wish to *cosmophotograph* is in *direct line* with their *cosmo*-cameras. This is easy to do as the two planets revolve on their axes. Hence, the Martians wait until the angle between the two planets is at an optimum. This also means that they may have to "shoot" their pictures through doz-

ens of city blocks—often even hundreds of miles through a section of the earth (and perhaps through Mars). They have even taken cosmographs of complete newspapers while they were being printed!

From all this it must be realized that the Martian Intelligence Department is well posted on all important happenings on Earth. Thus, for instance, every step taken in our atomic-bomb development was immediately known on Mars!

Why Martians Don't Visit Earth

One of our first questions naturally was: "Why don't you visit our earth?"

"We have—innumerable times!" was the not-too-surprising answer. "We first explored your planet over 475 million earth years ago, in your so-called Paleozoic era. We collected many of your fauna and flora. Your minerals were of no interest as Mars has identical ones. Many other trips were made in successive ages, but we found the procedure boring because your planet evolved in nearly the same manner as ours.

"Things became more interesting when man appeared, but, here too, human evolution was somewhat parallel to ours. For over 60,000 years now we have refrained from actually setting a foot on Earth as we had done in former ages. There is no valid reason for personal visits; but when we do make occasional tours, for special purposes, we never descend below the outer reaches of your ionosphere, i.e., 200 to 250 miles above the Earth. At that height you cannot see our nearly invisible space trajectories. There are three vital reasons why we do not wish to land on your Earth.

"First there is germinal danger for us. Trips to the surface in past ages have been uniformly expensive to us in explorers killed, due to contraction of virulent diseases which could not be counteracted quickly enough by members of our expeditions.

"Secondly, on Mars our average weight is 95 Earth-pounds. On Earth it is 270—too much for our frail legs to support. Worst of all, your planet's superior gravitational pull tends to make our large brains far too heavy for comfort—it paralyzes us! We compensate for this condition in our space trajectories; and, if it were ever necessary for us to walk the Earth, we could do so with gravitation repellers strapped to our backs. These devices, however, are bulky and make us skip and hop in an undignified manner. Then, too, we cannot live in your dense air. It gags and chokes us and makes our hearts race because of its high oxygen content.

"Worse than this your thick atmosphere deprives us of most of our customary sun's ultraviolet radiation which we get on Mars. To live we must have abundant ultraviolet rays.

"Besides there is no good reason why we ever should descend to Earth. You have nothing to offer us; we have all the Earth information we need, so why should we trouble ourselves needlessly?

What Happened to Planet V?

"Lastly," said the great Martian, "humans *en masse* are worse than your wild animals. You are still far too low in the evolutionary scale to suit us. The human race is wholly too rapacious, too unscrupulous to trust. If you learned too much of our science and of our present accomplishments, you would most likely use the knowledge for further devilry and warfare, which latter is obnoxious to us. In the end you would even try to make war on us, and we then would have to exterminate you.

"This is exactly what happened when 326 million years ago we foolishly befriended the greedy race of

OPINIONS from MARS COLUMNISTS

(Note. There are no columnists on Mars, because newspapers do not exist on the fourth planet. News is disseminated by TELEPATHOCASTS. As Martians do not speak, but make only birdlike musical sounds, all famous newscasters are known by three distinctive musical notes.)

DO-RE-MI: "Those pathetic little earth children have finally arrived in their tin wagon. Do not let us repeat the historic, bungling mistake we committed with the race of the fifth planet! Let the representatives of the vicious, war-ridden human race see and learn only what is good for their peaceful progress. We must keep from them everything that they could use for destruction."

SOL-FA-LA: "It must have been a terrible shock to these vain Earth kittens that we knew all about their plans and their coming. Now that their race has discovered atomic energy, let's be interested spectators and watch the gory humans exterminate each other in earnest!"

DO-SI-MI: "In the Earth race we have the best example of evolution with a curse. All the meanness, all the selfishness, all the destructiveness, all the misplaced vanity, are distilled into it from its worst forebears, crowding out all the noble and the good instincts. Of all the races in the universe, the Earth race occupies the bottom rung."

SOL-FA-DO: "I too agree with our High-Control that it was wise to admit the six humans, purely as an experimental venture. If we can demonstrate to them with our own example that every thinking race has only ONE enemy—Inexorable Nature—then perhaps there is hope for the humans. Yet, knowing their terrible past record, I hold no illusions. They fight each other rather than fight Nature, but Nature always bests them in the end."

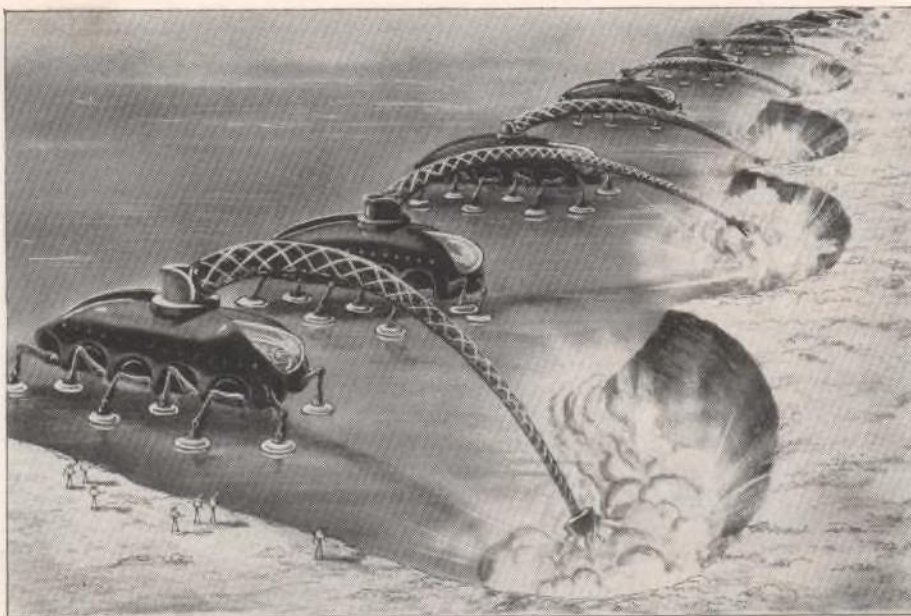
MI-SOL-SI: "The Earthlings have the rat's instincts. Nothing we can do will change that. Let us beware of them and keep all further Earthlings out, lest we come to regret it."

the fifth planet. They had learned most of our science and for two million years tried to invade Mars—the last time almost successfully! So we blew up their beautiful planet—about the size of your Earth, with three moons—with our then newly discovered *cosmatomics*. Today only billions of particles of this vanished world remain, gravitating in the orbit of the former planet between Mars and Jupiter. Your astronomers call this gravitating debris *asteroids*."

Mystery of Mars' Canals Explained

As we were speeding rapidly over the countryside, we noticed great arrays of fantastic structures—huge transparent pipes supported by high skeleton towers. They looked like monstrous aqueducts, but we were told that they were a planet-wide system of cosmic energy collectors and transformers. What looks like a single pipe from a distance, actually are two, one within the other. The inner pipe contains a thermic-radioactive liquid which keeps the temperature of the outer at a constant temperature level. The outer and larger pipe contains a vegetative type of thick liquid. Solar heat and its chemical rays and filtered cosmic radiation cause the constant and rapid growth of a highly specialized micro-plant life. After conversion at subterranean chemical plants, it is processed into proteins, carbohydrates (sugars, starches, etc.), and other foods. A high percentage of all Martian food is thus "grown" efficiently.

The countryside abounded with many other huge energy-sunplants of fantastic design. There were titanic, revolving, parabolic-lens mirrors to catch the



Blast-Fused Canals: By means of huge articulated machines, as large as ocean liners, Martian scientist-engineers disintegrate sands, rock and dirt atomically. Huge 1000-foot latticed booms sweep atomic "head" in semi-circles as machine "walks" forward at 3-4 miles an hour. Canals are 20 feet deep— $\frac{1}{2}$ to 5 miles wide, run over 3300 miles long.

sun's heat and rays. The mirrors follow the sun in its course throughout the Martian day (there are no clouds due to the extremely thin atmosphere).

Then there were skyscraper structures, shaped like an enormously tall book. They also revolved, always presenting their flat transparent sides to the sun.

We also saw curiously shaped towers spaced in geometrical patterns all over the land. At the top of the towers were arrays of porcupine-appearing rods. These were *sand-storm dissipators*.

The surface of Mars is largely desert, the sand of these deserts being an incredibly fine dust. As practically no rain ever falls on Mars, the desert dust is a major problem to the Martians. Even a light wind raises huge clouds of it. Therefore, the Martians built these dissipator towers, which by a combination of electric, cosmic, and atomic energy "lay" the sand dust that is always present and prevent it from swirling. By energizing certain towers they succeed, not only in stopping even big dust storms, but returning them to their point of origin.

Passing over a number of great Martian canals, we were naturally eager to understand their real purpose. Professor Percival Lowell, famed American astronomer, had been partly correct in evaluating their *raison d'être*. They were indeed irrigation waterways to provide water for the parched and water-poor planet which has no oceans of any kind. To distribute the necessary water over the entire land surface, the Martians, by means of atomic energy, *blast-fused* the so-called canals which are never deeper than 20 feet. By using atomic heat projectors,* the desert sands are fused into a homogeneous mass, down to a depth of 20 feet. Hence the waterways are completely lined with a thick glasslike mass, which allows no seepage of the precious fluid.

The canals themselves criss-cross the entire planet in geometrically straight lines and run from one pole to the other. The width of the canals varies from $\frac{1}{2}$ mile to 5 miles. Each waterway is tapped at numerous points along its route with lateral irrigation canals leading to various plantations.

Plant life, however, is not used extensively for food purposes by the Martians, as we already have

seen. Even fruit trees account for only an exceedingly small percentage of the total plant life. The purpose of the canals is two-fold. First they are used for irrigation to create fast-growing, tough, large-leaved plants. Plant life, as every schoolboy knows, helps to maintain the oxygen balance in the atmosphere by the decomposition of carbon dioxide. It does so on Mars too. The dense plant growth paralleling the canals for from 20 to 60 miles is also a most effective barrier for the eternal, distressing dust.

Second, there being no railroads or surface roads on Mars to speak of—due mainly to the ever-shifting desert sands and dust—the big waterways are used extensively for all heavy freight traffic. All other traffic goes through air.

What Makes the Waters Flow?

The greatest puzzle of the Martian canals for humans always has been: How is the water made to flow in them? The surface of Mars is perfectly flat, there are no mountains of any kind. Yet the water flows in the canals from the north pole right over the bulging equator during the spring and summer thaws. The flow is reversed from the south pole during next season toward the north pole. (Mars, like the Earth, is a flattened spheroid; the poles are 21 miles lower than the rest of the globe, according to the late Professor Percival Lowell.)

Yet all of us know that water cannot flow uphill from the north pole, up over the equator, and down toward the south pole.

The Martians do not use mechanical means to move the waters—although they could do so if there were no other means. The problem was solved in a much simpler manner. Furthermore, Professor Lowell erred in thinking that enough water could be evaporated on Mars by the sun and be condensed in the atmosphere, finally to be returned to the two poles in the form of snow.

The trouble with this theory is that there is only a pitifully small amount of surface water on Mars. Furthermore the atmosphere is far too thin now to form clouds, and has been in that state for nearly 900,000 years. Consequently only a small amount of water vapor is condensed nowadays and exceedingly little snow falls on the poles.

The Martians, threatened with extinction, perforce had to take heroic means to survive. This they

* This atomic method of constructing the Martian canals was first suggested by Hugo Gernsback in his novel *Baron Münchhausen's New Scientific Adventures*, published in the *Electrical Experimenter*, November, 1916, page 513—26 years before the advent of atomic energy.

accomplished almost a billion years ago when the titanic waterways were first considered.

The plan was as breathtaking in its audacity as it was grandiose.

The problem resolves itself into four parts:

1. Nearly a billion years ago Mars had two polar ice caps, as we have on earth today. Century after century these became smaller as the then-forming deserts absorbed the waters, never to return them. It was decided to build a ring of atomic, artificial water generators at both poles. For raw material the Martians have an almost inexhaustible supply of desert sand. This is transmuted atomically into water at the poles; the hot water is then conducted into huge artificial lakes where it freezes solid during the arctic nights. Titanic artificial moats surround the poles. These moats—built with atomic blast-fusing machines—are waterproof; hence, no precious water is lost. All the canals end in these polar moats.

A Brilliant Solution

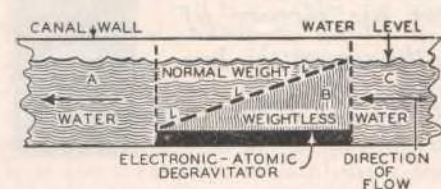
2. When the spring thaw comes, the canal terminals rapidly fill up with their life-bearing water. *But the canals have no slope; it cannot flow. Worse yet, the Martian poles are depressed 21 miles. Hence, the waters actually must run uphill to start their journey.* We shall see how brilliantly this problem was solved.

3. To bring the essential water to the distant cities and industrial plants, the canals were built in less than two Martian centuries (400 Earth years), entirely by the atomic blast-fusing process. To understand the immensity of the project, one must realize that some of these huge waterways are over 3,300 miles long, and over 5 miles wide.

4. But the canals themselves would be useless unless water flowed in them constantly. And it does so at the rate of 51 miles a day, or 2.1 miles an hour, according to accurate measurements made by Professor Lowell, at Flagstaff Observatory.

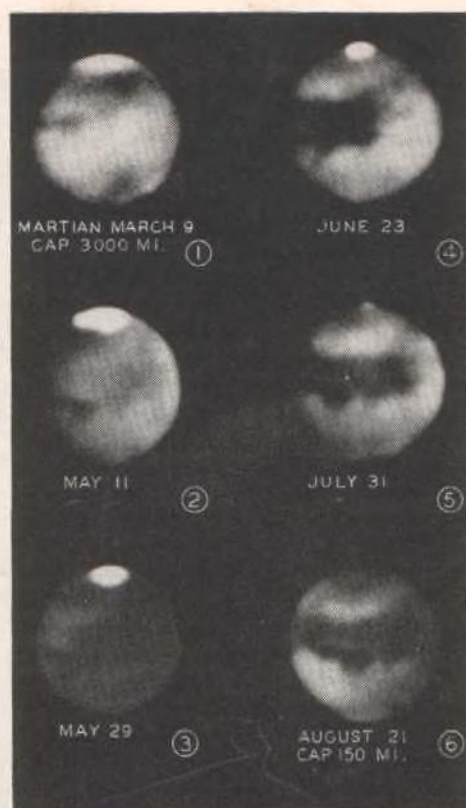
Here the Martian engineers stepped in with electronic-atomic means. Every 2,200 yards there is built in at the bottom of the canal an *atomo-electronic degravitator*. The latter device is only 1 foot thick but runs entirely across the canal. It is usually about 10 feet wide (see cut).

Near the pole, the water starts flowing down a decline, setting it in motion. About 2,200 yards down the canal, the water moving at the rate of 2.1 miles an hour hits the first degravitator. This is now energized for a few seconds. During this short time, the water becomes weightless in a varying degree as shown by broken lines L—more weight at the left; no weight at all would be registered at the right.



The effect on the flowing water C is as if the weightless body of water at B did not exist. C therefore pushes B out of the way. This now forms a wave at D in the second figure. In the meanwhile water A has moved on. Now wave D collapses—as the degravitator has ceased to operate. It mingles with the lower-level water A. Its full weight returned, it helps to push A on its way. In this it is helped by water C, which acts as if it had been sucked into a vacuum

Mars Ice Cap: Polar ice melting in spring and summer. 3000 mile cap reduced to 150 miles in 3½ months. The melting ice fills canals with water. Photos by Flagstaff Observatory, Flagstaff, Ariz.



when D was lifted out to form a wave.

Stripped of all technicality, the water degravitator acts as your hand does when you impart a swirling rotary motion to the water in a basin.

The amount of power used in one degravitator is relatively small. All the degravitators spaced along the canal must work in unison to move the water.

The advantage of the degravitation propulsion of water is mainly that there are no moving parts, no machinery. This method also makes it simple to reverse the waterflow next season to the other pole.

Martian Housing—Underground Cities of Mars

Our transparent flyer came smoothly to a stop in a small round plaza on which we saw ten or more similar transparent flyers either landing or taking off. Each landed or departed from a colored, round marker exactly the size of the flyer's circular base. Alighting, we immediately found ourselves on a moving strip which rapidly carried us to a large, circular opening in the center of the plaza.

Martians, we were told, have their homes nearly a mile below the planet's surface where the temperature

is always constant, thus evading the discomforts of the severe Martian climate.* The Martian works on the surface of Mars, but his home is *inside* the planet. Wherever feasible, Martians have their home *directly* below their place of work, or nearly so. *The State frowns*

upon all horizontal travel to and from work. Thus, the Martian office or factory worker merely takes a constantly moving express platform down to his home—or up next morning—the trip never lasting more than a few minutes. *There are no traffic problems on Mars.*

(Continued on page 61)

* At the equator the maximum daily temperature may be about 50°, falling to 40° or 50° below zero at night, according to Prof. Donald H. Menzel, of Harvard College Observatory.—Editor.

EXPLORATION OF MARS

(Continued from page 11)

There is only *one* underground city for the 2 billion Martians, but it is enormous. A mile down, it runs through thousands of miles *continuously under the entire subsurface of Mars*. Only about 600 miles near the poles are subcity free.

This planet-wide city has vast cavelike, domed roofs with no visible supports. This artificial sky is smooth and pale-rose colored. Artificial suns fed by cosmic energy light the streets and houseblocks so brilliantly that you have the illusion of being on the surface of Mars at noon. The artificial suns also simulate the real sun's high ultraviolet radiation, without which the Martians could not exist.

The temperature never varies in the vast underground city; the air is filtered and ozonized—there is no accumulation of dust at any time. If dust appears from wear and tear, it is immediately removed by electrostatic suction. There are vast parks, immense recreation centers, and amusement arenas every few miles, in all directions.

Varispeedbelts

Yet there is not a single passenger vehicle in the streets—ever. Below the city is a complex transportation system of fast-moving *varispeedbelts* which take you into any direction. For freight deliveries there is a special system of subspeed belts with outlets under every city houseblock. Nor do you have ever to mount or descend steps. On every city block there are endless inclined *rampbelts* which take you from the street directly to the varispeedbelts. The latter are never used by Martians to travel further than about 20 miles. For greater distances they ascend to the surface, and travel by transparent flyer.

The houses themselves are huge translucent blocks about 2,000 feet square, vaguely similar to earth apartment buildings. The houseblocks are uniformly terraced, never more than 10 stories high.

The moving strip already mentioned took our party rapidly underground, and we alighted near one of the huge houseblocks. We stepped inside (there are no "doors" on Martian underground houses) and onto an indoor inclined moving belt which quickly took us up five stories. Here we stepped on still another horizontal belt which took us down a long hall, brilliantly lighted.

Stepping off near a curious luminous marker, we found ourselves in a spacious sort of foyer. A panel moved automatically to reveal a very large, beautifully illuminated room. *It was, however, completely bare.* The floor was pleasantly soft and warm; yet there was neither rug nor carpet. The walls and ceiling continually changed in an incomprehensible manner in color, in design, and seemingly in perspective too. All this was pleasing, but puzzling. Later we realized that it had something to do with Martian esthetics, but they could never make us wholly understand.

The "Fluid" Home

Quipped one of them: "You are still children in esoteric culture. Besides, you lack several of the senses needed to understand most things Martian."

We were still standing at one side of the bare room when our leader began to wave his antennas in a curious manner. Suddenly openings appeared in the ceiling and walls. Within seconds all sorts of furniture had been moved into the room as if by magic—enough to seat all of us.

At the same time several walls pushed in from two sides, making a comfortable medium-sized livingroom. The new panel walls cut up the huge room into a complete apartment. Besides seating furniture, many other strange pieces followed—tablelike objects, cabinets, couchlike pieces, and others.

We now walked through one of the mobile walls and found ourselves in a "bedroom." More of this further on.

We finally understood that the Martians accommodate their apartments to the size of their families. You can transform your home in the twinkling of the eye; you may have a ballroom or a cozy livingroom or a gymnasium or a game court—or a theater, all within seconds. If you have many guests, you can have a temporary large livingroom. If you are alone, you may have a tiny one with only the furniture required for that evening or day. Your home thus becomes "fluid," as the Martians term it, never static. With such immense variety, one never gets bored with one's habitation.

You never raise a finger to transform the bare room into the most elaborate apartment. All the furniture is stored in the wall recesses. By telepathelectro control, the Martian brings out any room article he requires at a second's notice. He reverses the process, storing the furniture, whenever he so desires it.

There is practically no cleaning in

such a home, as there is no dust. As soon as the furniture is stored in the walls, a powerful electrostatic vacuum suction is applied, which catches even the tiniest speck of dust.

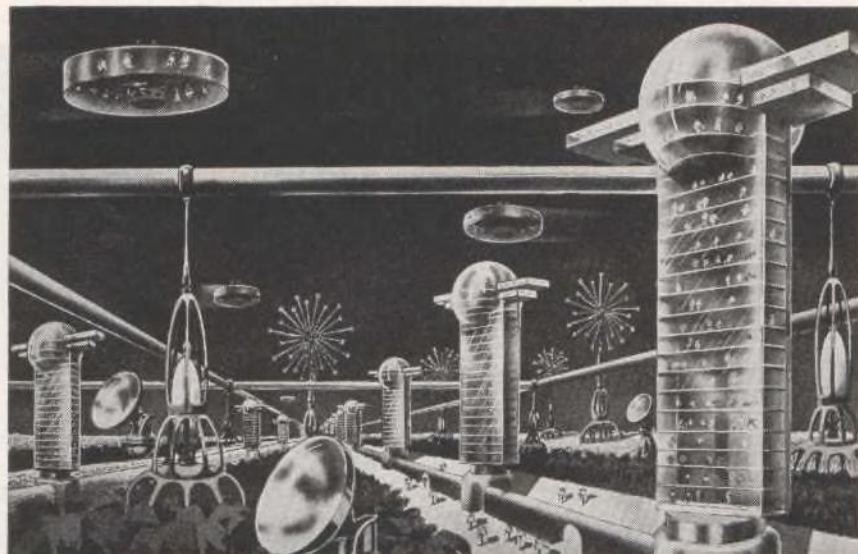
An Ancient Crime

Our reference to crime on Mars was highly amusing to our mentor. There has been no recorded Martian criminal case during the past 950 million years! "Where do you think you are—on earth!" quipped the leader. "Remember, we have telepathic organs—and someone in the population would surely detect any criminality. The last known projected crime did not succeed. This individual intended to take *two* baths, in the 60-day period, instead of the lawful one! You know by this time the importance of water on this planet—and that makes an illegal bath a highly criminal act.

3,000-Year-Olds

The Martians have had a very high culture for over 1½ billion years. Having conquered practically all diseases and solved the main aging processes, they live for thousands of years (earth years). A very small minority of Martians are over 5,000 years old. The preponderant age is 3,000 years—yet one cannot distinguish a 50-year-old from a 2,500-year-old. *There are no age-ravages such as we have on earth.*

But the planet cannot support more than 2 billion Martians, due mainly to deficient water and food supply—but also to insufficient living space. Hence new births are strictly controlled by the *National Health Control*. Martians die only rarely by accident, and mostly by euthanasia. At his or her 3,000th birthday, the Martian, having fulfilled his destiny, is put to death painlessly, to allow for new births by *voluntary selective breeding*. This improves the race.



Martian Surface City: Revolving skyscrapers with round domes; "porcupine" sand-storm dissipators in background; transparent "cheesebox" flyers overhead. Food-culture pipes cut across city; solar heat collector in foreground. Martian skies are nearly black in daytime due to rarefied atmosphere. The sun is brilliant in dark sky.

A number of exceptional personalities, such as scientists, inventors, and those having rendered extraordinary services to the race, may be allowed to live 5,000 years and more. In order to do so, however, the candidate must have a popular vote in excess of 60% of the entire population. Martians never lose their fertility; females can give birth up to the end of their long lives.

Transplanted Heads

We were told that successful transplantation of Martian heads had been practiced for some 150 million years. During our stay 280 heads were transplanted for such reasons as scientific research, selective-breeding purposes, accidental maiming (loss of arm, legs, etc.) In this case euthanasia candidates are selected by the National Health Control who transplant the head of the maimed individual onto the body of the Martian about to be eliminated.

Transparent Martians

One of the main reasons for Martian longevity was the invention of the *translumscope*—far more efficient than x-rays, which give only shadows. By means of this instrument a light source far more powerful than the sun, but giving out cold light, is directed on any desired part of the patient's body. With correct focusing, the instrument will transilluminate any organ selected within the body. The light source is so intense that it easily penetrates and illuminates the deepest bodily recesses. By means of special, sensitized, focusing eyepieces, the physician can actually see every living organ within the body. He can see all the blood vessels—inside and out, the interior of muscles, nerves, and even the marrow of the bones. Any irregularity, any pathology of the organ can thus be clearly seen and then treated accordingly. Fevers, infection processes, are easily seen and followed through the blood stream and any part of the body.

Martian Females the Deadlier

The Martian female is about 6 inches shorter than the male, her average height

being 9½ feet. She also has, from the human viewpoint, a more shapely waist than the male. Her outstanding characteristic, however, is her double antennas; she has four of them in contrast to the two of the male. She also makes different sounds than the male. Martians of course cannot speak like humans due to the thin air on Mars—they give off curious bird-like, high pitched sounds.

When we asked our leader the evolutionary reason for the female's double antennas, he twittered so loudly and audibly that I could hear it over my plastex helmet phones. Quipped he:



1015-26-95989-59

"The double antennas allow her to double-talk better! This confuses the male better too!" A humorous remark, which we found out later, was not without a good deal of truth.

Indeed, the females on Mars are the *REAL* rulers. They hold all the important positions of the entire planet, and the highest council, the *Planet Conclave* is composed of five *Universal Judges*, all females. This is the supreme authority on Mars, the titular head of the two billion Martians.

The quintuple Conclave members are elected for life. The law, however, allows no member to be elected until she has reached her 2,000th birthday. This gives the new co-ruler 1,000 years of office life.

The Martian female has an average of 1½ children. She seldom has her first child before she has reached the age of 1,500 years, because, by law, she cannot have offspring until her turn comes.

The Marriage Scientific

All marriages are scientifically arranged; no one just falls in love and marries. All candidates are selected *first* with a view to bettering the race. Then comes a long list of 129 tests which the intended couple must pass. A single failure on any one test may disqualify one or both candidates. This, however, happens rarely because Martians have been scientifically bred for so many thousands of generations that today there are few physical differences in the race.

Her 129th Divorce

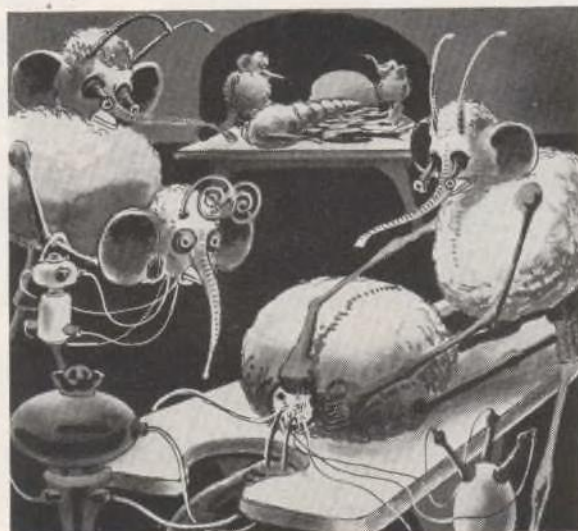
Due to the longevity on Mars it is not at all surprising that the average marriage lasts "but" 47 3/9 (earth) years. Long as this seems to earthlings, remember that Martians are on a much higher level intellectually and culturally than humans. Martians can marry any time after their 30th year—but no children may be born till the couple's serial rotation number comes up. They may terminate their marriage (divorce) by mutual consent before a special *Dissolution Court*. Recently No. 1015-26-95989-59, female, age 2,869 years (a canal researcher), obtained her 129th divorce—not a record by any means.

Marriage Considerations

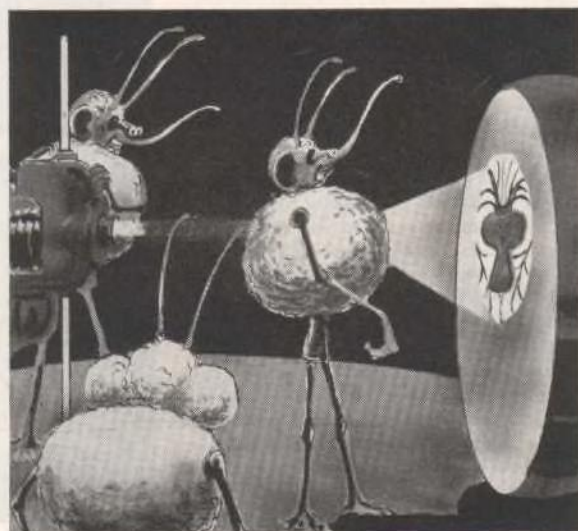
On Mars people rarely marry for love or sexual attraction. This is indeed far down the list of reasons. The prime motive is intellect. The female always searches for superior intelligence, for accomplishments, for ability. It is the female who woos, never the male.

When she has made her choice, then she and the intended must submit to the State tests. These passed, the couple may then marry immediately. The male has no choice in the marriage preliminaries—if he is chosen, he cannot refuse (unless he is already married).

The females, however, don't have everything their way. Frequently when their dominance becomes too great, the males go on strike *en masse*—millions of them refuse to make love to their wives! The last "sex-strike" 14 years ago, involving over 2½ million males, lasted 5½ years. The males won!



Head Transplant



The Translumscope

Sleepless Martians

For more than 1½ billion years the Martians have not slept. Early in their evolution they decided that the race must end the intolerable condition whereby the population wasted one-third of its life in useless and unproductive slumber.

Their scientists already had found that certain individuals could get along with much less sleep than others. As a first step these persons were carefully dissected after death. It was discovered that they had slightly different adrenal glands than normal persons. These glands secrete into the bloodstream an unknown hormone X, which is now known as the *antimorph* (anti-sleep) hormone. It simply neutralizes the toxic, acid substances which are created in the body by fatigue and thus induce sleep.

The second step was to mate by *voluntary selective breeding* all the known sleep-resisting individuals. Successive generations—as expected—needed less and less sleep, until finally they no longer needed sleep at all. The modern Martian now has separate *antimorph* glands, located near the adrenals. This allows him, not only to go without sleep forever, but also to do an astounding amount of physical work, when necessary, without collapsing. But during such an emergency he must ingest more food pellets to balance his caloric output.

Of course, the Martian must relax sometime during the day; he cannot go at top speed forever. He relaxes simply by retiring to his restroom—we would call it a bedroom. He has such rooms at home or wherever he toils.

Martian "Bedrooms"

These are plain spherical rooms bare of furniture. The wall and ceiling are (to us) weird, with their peculiar, chameleon-like colors which are forever changing in tone. The pastel-like colors constantly mix in ever-changing hypnotic patterns, never to repeat.

To Martians this is delightfully restful. When they watch these curved walls, they confess that their normal thinking processes stop entirely—they now must relax completely. During the entire rest process their eyes never close once. They gaze as if transfixed at the wall or ceiling.

Not even the slightest sound can penetrate the walls of these restrooms; they are as quiet as the tomb. Furthermore, when in use, the room is "insulated" with a "screen" of a special cosmic waveform which completely cuts off all telepathic thought waves.

Finally, the body must relax too—**COMPLETELY**, in every sense of the word. When the Martian enters the restroom, he bends backward and places his head on a headrest mounted on an upright shiny pillar. He next fastens a straplike band over his forehead, between his nose and his antennae. Then he presses a button attached to a projecting timer on the pillar.

Instantly his body is made completely weightless by the action of the floor degenerator. Having no weight, the body would float toward the ceiling if the

Martian had not secured his head to the pillar. Consequently, he floats horizontally, but stays secure in one position. There is no more delightful sensation than complete weightlessness—the body freed from gravitational pull.

In 15 minutes one obtains more *real* rest than during a whole night's rest in bed. We already had experienced this in our space flyer during our Earth-Mars trip. Now we could understand why the Martians retire to their restrooms for 15 minutes once or twice during the Martian 24-hour day.

Let earthlings not wonder too much about the never-sleeping Martians. The human heart, too, never "sleeps" during man's entire lifetime. True, the heart does *not* beat constantly. It, too, must relax—indeed during 24 hours, it normally works only 12 hours. But when you run or exert yourself, then your heart beats faster, getting less and less rest.

Mars Not for Humans

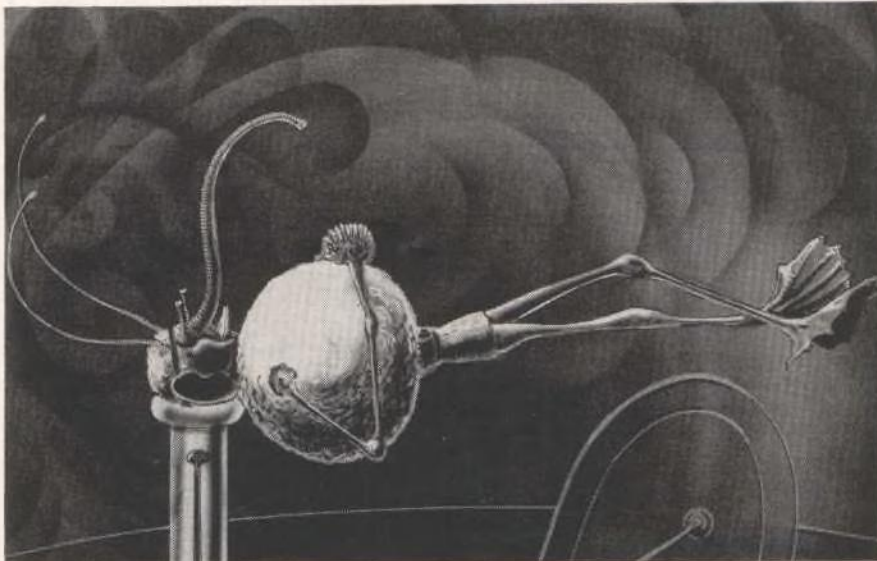
This account is written in our underground home—in our fluid, "one"-room

in a tenuous atmosphere, they do not speak like humans, as already explained—they make whistling sounds not unlike birds. They have a wide range of musical sounds. Despite their telepathic organs, they normally converse by sound.

When this is not possible—remember sounds do not carry far in the rarefied air—they communicate by thought waves. In the huge auditoriums, even when their musical sounds are amplified, the "speakers," actors, or performers usually employ telepathy as well. They do this to put their talks or performance over more emphatically. It also expresses the personality far more forcefully.

Martian Politics

There is naturally no such absurdity on Mars as different nations. There is only one "nation"—the entire race of 2 billion Martians. There is little politics on Mars, as we understand the term, chiefly because candidates are universally elected for life after they have reached their 2,000th year. This system discourages the usual political rivalry known on earth. It also makes for an ideal stability



Resting Martian: Sleep being unknown on Mars, Martians nevertheless have short rest periods during day. Above is a male in degenerator room, freed from gravitation, completely relaxed. Fast moving hypnotic wall-patterns keep him immobile.

apartment. The Martians have provided air pressurization; otherwise we would have had to wear our plastex sphere helmets constantly. The apartment therefore has the same air pressure as on earth—14.7 pounds per square inch. Our hosts also provide us with the necessary oxygen for the tanks strapped to our backs, whenever we leave our houseblock.

The Martians throughout their long evolution have become used to their thin atmosphere, which is as thin as that of our upper stratosphere. Humans, however, cannot live in such an oxygen-poor, pressureless air. Without our helmets we would immediately gasp for air and become unconscious in a few minutes.

Conversely, when our Martian leader visits us in our home, he must wear a helmet, else he would soon choke to death in our high-pressure atmosphere. The Martians having no mouth like ours, nor teeth, but a sort of beak, and living

in all "national," regional, and local offices. Every officeholder thus becomes an institution. Surprisingly, the average Martian keeps a very sharp eye on every official. Indeed, she or he is under continuous fire—this keeps all officeholders on their toes. They are seldom replaced.

Synthetic Food

For more than a billion years, the Martians have "grown" their own food synthetically (see page 9). They eat no animal food of any kind, although they did so in prehistoric times. What little is actually grown on trees, such as fruit, nuts, etc., is pure "luxury food" and represents less than 10% of the total.

Martian food engineers—*pateilogs*—can produce billions of food combinations, surpassing anything we know on earth. Simply by juggling the atomic content of the raw materials, any type of food can be made and any desired

taste can be given to it. Practically all synthetic foods are stable at room temperature and will not spoil for centuries if kept in hermetically sealed containers, because all Martian foods are bacterialess—contain no micro-organisms of any kind—thus there is nothing in their content to ever spoil them.

Every day we eat "steaks," far better than the best terrestrial filets mignon; "potatoes," delicious beyond compare; desserts that are an everlasting delight to us; "milk," rich and creamy—yet everything we eat is purely artificial food.

Martian Protein Works

We visited one of the mammoth protein works, but naturally could not make head nor tail out of what was going on. There were hundreds of vats, tanks, labyrinths of huge, weird tubes, ovens, mixers, atomic converters, cosmic "blenders"—

and thousands upon thousands of outlandish instruments, gauges, and manipulators. At one end of the plant, reddish-looking sand and a thick brown fluid came in—at the other end a constant stream of packaged food flowed out to be distributed by underground conveyors to storage plants.

Remote Control Workers

Yet there was not a single Martian in this huge plant which manufactured over 6,000 tons of protein food daily. Next we went to the control room from whence the entire plant was run by remote manipulation. This was above the main plant and housed only 15 technicians. Here we saw a forest of instruments, knobs, and hand controls on large panel signal boards. In comfortable reclining chairs, suspended from the ceiling, the technicians watched the instruments be-

fore them. In one hand they held recorders on which holes were punched by them into a metal ribbon. This was their "log book." We noted many television-like panels which allowed the workers to watch any operation in the actual factory that contained not a single worker.

Martian Food Magic

What was not immediately apparent when we watched the packaged food emerging on the conveyors was one amazing factor. It only became clear when we picked up a small package about the size of one of our breakfast cereal cartons. It was astonishingly heavy—it must have weighed over fifteen Martian pounds! All Martian foods are highly atom-compressed. This not only saves a tremendous amount of space, but, when shipped, most food items are not "aged."

We asked to open one of the "steak" boxes. It contained a great quantity of brown, round disks about the size of a twenty-five cent piece, but over twice that thick. Our mentor took one of them and placed it on a round plate that resembled plastic. He then reached into the scalelike skirt hung from his waist and brought out a pencil-like gadget with some small knobs on two sides.

He now pointed one end of the "pencil" at the brown disc, and before our astonished eyes it quickly expanded in all directions till it measured about 4 inches in diameter by 1 inch thick. While this transformation took place, the appetizing round object started to "steam" and sizzle; and if our heads had not been encased in our airtight helmets, we would have inhaled a delightful, meaty, warm aroma. Within 10 seconds, the "steak"—for such it was—was cooked, ready for eating.

The pencil gadget was an atomic instrument that rearranges the atoms in the "green" compressed steak and then cooks it by atomic energy.

A large, hot glass of milk is made in similar fashion merely by taking a little white tablet $\frac{1}{4}$ by $\frac{1}{8}$ inch in size, dropping it into a glass, and pointing the atomic pencil at it. No water is added, all water being atomically locked in the original tablet.

It should be understood that all foods are compressed with their necessary seasoning, sauces, etc. Naturally there is a wide variety to choose from.

Incidentally, when the Martian goes to an eating place, he merely orders the items, puts them on plates, into glasses, etc., then expands and cooks or heats them himself. No one touches his food except him. The atomic pencil can supply any degree of heat desired. For foods requiring expansion (molecular expansion causes heat also), only the "expanding" button is used.

Water, the most precious Martian commodity, is meter-rationed. Every person is allowed 210 didisis of fluid per Martian month (60 earth days). The meter shuts off automatically if the household quota is exceeded. All used water is reprocessed *ato-chemically* in the house-block.

WHAT MARTIANS ARE SAYING

(NOTE. The 2 billion Martians have no names, but serial numbers. Females end with odd numbers.)

10¹⁵-11-4969-2, *National Zoologist*: "The female of the species is still the sexier!"



Tasting Electronic Music

10¹⁵-31-2169-14, *National Medicoördinator*: "The council must warn our population emphatically once more against the excessive use of gaseous food inhalation. If taken exclusively over long periods, serious *telepathology* follows. Keep gaseous food below 20% of total diet."

10¹⁵-8-97-169-17-12, *National Research-Telepathist*: "How far apart in the evolutionary scale we and the Earth people are is best observed when we see them asleep."

We who never sleep are deeply shocked when we actually see the revolting spectacle of beings—even with low-grade intelligence—wasting a third of their lives in useless somnolence. It is doubtful, when, if ever, they will develop our *antimorph* glands."

10¹⁵-59-67098-26, *National Religionist*: "The human race has produced one and only one individual who merits our complete admiration: the Hebraic Jesus Christ. Alas, his teachings continue to fall on deaf human ears."

10¹⁵-17-7889-99, *Feminaturalist*: "Sex, with our females, is still as modern as it was two billion years ago."

10¹⁵-16-95469-19, *National Actress* on her 2,500th birthday: "I am over-

come with gratitude to my race who so overwhelmingly willed that I may now have a child."

10¹⁵-9-22269-16, *National Health Control*: "We must seriously protest the recent female vogue of excessive inhalation of intoxicating odors. Odor drunks are a National disgrace. It is worse than alcoholism."

10¹⁵-16-8879-24, *National Science Control*: "In another three billion and a half years, our sands which we now transmute into water will have given out. As a new source of raw material we will have to cut up our barren smaller moon, then the Asteroids."

10¹⁵-5-6656-8, *National Comic*: "As



Gaseous Food Inhalation

comical as a serious human."

10¹⁵-29-28982-16, *National Moralist*: "The most grotesque sentence ever coined in the Universe: *Peace on Earth* (Planet III)."

10¹⁵-19-46489-30, *National Gustumusicritic*: "The recent *Gustonepoem*," by 10¹⁵-16-94864-60, now in such universal demand, has lifted the entire art to solar magnitudes."

10¹⁵-11-59911-79, *National Nature-Educator*: "While interviewing the little humans of the earth expedition, I was more than astounded at their fierce, childish belief in heaven and hell after death. What ludicrous, abysmal gibberish! As if they did not have an overabundance of continuous hell on earth!"

*The Martians have combined music with electronic tasting. Earthlings are familiar with a strange taste sensation when for instance the two poles of a dry cell touch the tongue.



Atomic Food Broiler

Radio Books

Martians get their news by radio-guided telepathy from state news centers. Printed books and magazines have not been produced for many millions of years because of lack of space for the myriad-trillions of books.

Simple home radio receiver now micro-etches book pages (with or without illustrations) on thin, transparent, everlasting metal tape, about $\frac{1}{4}$ inch wide. Each micropage measures $\frac{1}{16}$ inch high, by $\frac{1}{32}$ inch wide. A 1,000-page book thus takes only a 31-inch-length paper-thin tape. To read the book you press a button. The tape then feeds into the *vision position*, and you read the pages on the screen, as fast or slow as desired. These "books" are all broadcast free by the state. Thousands of books can be stored in a single small reel that fits your hand.

Miniscule Humans

Currently the Martian home hobby is *microzoology*. Just as Japanese grow miniature trees, so Martians cultivate diminutive animals. They breed the counterpart of Martian horses, cattle, monkeys, and birds, as small as ants. These are raised in transparent table *zoolariums* among miniature trees, shrubs, and plants. The zoolariums are equipped with powerful magnifiers, so that the animals can be comfortably studied by the hobbyist at all times.

We were also shown an almost perfect, humanlike race of miniature people, bred by a Martian science-zoologist. The little men and women were less than $\frac{1}{2}$ inch tall. By means of amplifiers you could hear them talk their weird language. They were still in an aboriginal stage, savage and naked. In about 4,000 years (850 generations) they would be at the same state of evolution as present-day humans, according to the scientist-breeder.

Atomic Chess

Greatest sport on Mars nowadays is a game which is best described by the term *atomic chess*. It is the most intellectual *tour de force* imaginable. The game is played with 126 "pieces"—all the Martian atomic elements. But the players use no actual "pieces"—it is all done mentally like blindfold chess. Each player plays with 126 different atoms which he must use in correct chemical

combinations with the others. If he makes a mistake, he loses one or more atoms to his opponent. As there are billions of possible combinations, it takes a gigantic intellect to play the game rapidly, with only 10 seconds allowed between moves.

Every night for two hours, two giants of the game play a match, although the two players may be separated by thousands of miles. The contest, broadcast pictorially over every home screen on Mars, is followed breathlessly by well over a billion Martians.

Cosmic Pleasures

One of the baffling mysteries of Martian homelife which we could never understand—due to our limited senses—was the following:

Every evening at the same hour, all Martians, who were not at work, would relax and assume a curious posture. Their antennas curved till they almost met the projecting eyeballs. Soon an ecstatic expression would come over them and then their bodies became rigid. They stared fixedly into space for half an hour during which time no one could rouse them from their trance.

We understood this had something to do with a cosmic transmission that seemed to transport them into another world. One of our zoologists thought it had a connection with their sex life. But we never found out.

The Planet Comes First

The high-intelligence Martian civilization with its more than 2 billion years of evolution behind it, cannot possibly be compared with our own. Long evolution, voluntary selective breeding, have profoundly affected all Martian thinking, all customs, all living, to such an extent that we look, to Martians, like 20th grade savages.

Mars has no armed forces—what would they use them for? There are no criminals, consequently no jails. Policemen have been unknown for over a billion years. Labor troubles are unheard of. There are but few courts and they have little to do, outside of divorce cases.

All this, of course, stems back to the efficient planetwide, billion-year-old educational system which teaches that *first, whatever the individual does must be for the good of the planet, second for the race.*

There is no such thing as a government as we know the term on earth. The Martian central organization is only a statistical body which gathers facts.

There are no "laws" as we know them, merely *Instructions* which everybody obeys as a matter of course. Just as the majority of Americans obey our street traffic lights—even if there is no policeman around.

No Money

There is, of course, no money and no such vicious, cancerous outgrowth as interest on money, no taxes. Consequently there is no such thing as business, as we know the term, because on Mars no one can make a profit.

For over a billion years Martians have been conditioned to work for the good



Food Technician

of the race and for each other. *Whatever is produced belongs to the race.* Every Martian does his appointed task, each and every day—there are no "Sundays" or holidays. But he works actively only for 20 Martian months. Then he takes off 4 months, for a vacation, if he wants. (The Martian year has 24 earth months.) Few Martians however take the full 4 months—the average is $2\frac{1}{2}$ months.

Naturally, statistics are kept on his working time—not to check on his non-working hours, *but to keep him from putting in too much time.* Like the bee, the average Martian is overambitious and many workers over-exert themselves in their positions. This is frowned upon.

Fine living quarters, according to the size of the family, are assigned to every Martian over 30 years old. Naturally he does not pay for it in money.

The same is true for *all* his wants. He has merely to produce his metal card which gives his "name", i.e. his serial number, and he can "buy" anything he wants, anywhere. The electronic *stato-register*—connected with the Central Statistics Office—records the "sale" to his serial number and that is all. Incidentally, every item, be it a glass of milk or a piece of furniture, has an assigned number. This, when "bought", is recorded after his own serial number, thus completing the transaction. At the end of the year a complete account is sent to him. Each item is valued by a point system. Thus a dinner at a "restaurant" may run to 461 points, while a special cosmo-camera may run up to 16,000 points.

His work is credited to him in a given number of points, according to a universal scale. No Martian ever overdraws this point account—usually he is far below it and has credits coming to him.

Incentive

What then is the incentive for the Martian? What makes him work so furiously and so zealously? The average Martian has been bred for millions of years to think first of his planet—*THAT* is his spurring force—and he is proud of it. Many Martians distinguish themselves, but never for material reasons. The honor of doing something important, in the sciences, the arts, new inventions, new production, etc., is also a powerful motive.

(Note. This story was first printed in Hugo Gernsback's annual Christmas booklet: "QUIP", December, 1949. Copyright 1949, by H. Gernsback.)



Foreword

Since the early thirties, every Christmas I have printed an annual greeting booklet in lieu of a Christmas card. These booklets, in several colors, measure about 6½ by 5 inches and contain from 26 to 36 pages. For a good many years they satirized the cover and format of a well-known magazine. From 5000 to 6000 booklets were printed annually and circulated among my friends in the radio-electronic and publishing industries. Every idea and word in these miniature magazines is a product of my pen.

The 1950 issue was titled *Newspeek*. Its cover bore the legend, "World War III—in Retrospect." The story showed a problematical future world war—and in the main was written to bring home the futility of War.

Exactly 10 months later—on October 27, 1951, Collier's magazine brought out a special issue labeled "Preview of the War We Do Not Want." In this issue was duplicated the entire basic idea of my then 10-months-old "World War III—in Retrospect," except that the 128-page Collier's version was longer, gorier—and most important—it used the Atom-bomb.

For the record, note, that exactly 9 of Collier's editors and staffers were on my mailing list. Hence, "World War III—in Retrospect" was well-known to Collier's organization. Nevertheless, no credit for the idea was given in Collier's.

For some time, many of my friends have urged me to publish "World War III—in Retrospect" in a general circulation magazine. I am doing so now, in order to acquaint you with the original story. It is reprinted here, exactly, with one change—for in the 1950 version, World War III started in 1952—Collier's, incidentally, copied that date, too! It will be seen that I also changed that date to 1954, in the present version.

—Hugo Gernsback.



The Submarauder

THE U.S. ON DECEMBER 25, 1966

Meaning of the Peace

The long road from Korea 1950 A.D. to the signing of the peace treaties with Russia and China last week, after 14 exhausting war years, is at an end.

True, the shooting war was over ten years ago—March 1955—with the signing of the two armistices with our erstwhile enemies; nevertheless, till the two enemy states had fulfilled their obligations; there could be neither a true nor legal peace.

With the world peace celebration at an end now, let us take stock as far as the United States is concerned.

The provisions of the peace treaties with Dr. Popoff's Russia and Ming-Soong's China specify U.N. occupation of both Russian and Chinese key cities and a total of 59 strategic points in both countries for 40 years longer. (The armistice terms specified a total of 50 years, of which ten years have already elapsed.)

The U.S. share of occupation troops will be a total of 520,000 men to guarantee the peace during the next four decades. This will be a high cost to bear by the already overburdened American taxpayer, but it is cheap if it assures 40 years of peace.

After all, the few billions a year that it will cost us is insignificant compared to the present U.S. national debt of 4,670 billion dollars. Further, we must be prepared to continue to help the backward nations of the world for many years to come, if we do not wish population explosions to occur in the Asiatic pressure centers of India, Pakistan, and Indonesia, who now have a total population of 496 million.

Atomic energy must be provided on a grandiose scale for these Asiatics, as well as for other pressure centers of the world, particularly the "have-not" countries, if permanent world peace is to be maintained.

As has often been remarked during the past ten



WORLD WAR III

— IN RETROSPECT

by HUGO GERNSBACK

(Illustrations by Frank R. Paul)



years by our statesmen: Cheap atomic energy is the key to world peace. The near-extinct Communism or other new isms cannot breed discontent or engender wars if the world's populations have everything they need.

Nevertheless the U.N.'s vigilance over atomic energy must never cease. Power plants in the hands of revolutionists seeking world conquest could manufacture electronic-guided, trans-world weapons in less than a year. Hence the more atomic plants in various parts of the world, the greater the need for U.N. supervision. This again means more U.N. manpower, not only in inspection bodies but in far-flung intelligence staffs. That automatically means a further drain on the world's taxpayers.

U.S. Money Reform

Congress' most pressing business in 1967 will be obviously a practical and sensible dollar reform. Compared to the pre-World War II purchasing power, the U.S. dollar last week was down to 10¼ cents. It has been steadily declining since 1941, with few reversals in the trend. True, the dollar has company in this, as nearly all money units the world over have similarly declined, with the exception of the Swiss franc.

None of the hundreds of proposals that have been made lately, by economists and others, for a real

money reform seem to hold water. The radical school of world-wide repudiation of all state debts is looked upon with horror and dismay in Washington, London, and Paris.

On the other hand, the *atom-energy dollar*—the AED—as a uniform world currency seems to gain strength as the months pass. Such a currency based upon the atomic-energy kilowatt—instead of gold—would have the same intrinsic value always—just as the meter or the yard. As atomic energy becomes cheaper the purchasing power of the AED increases. The only fly in the soup: how and on what basis could the world's nations convert their present state debts into atom-energy dollars?

Frank R. Paul

Mr. Paul was the first science-fiction magazine illustrator in the field in 1926, and has become the most popular and beloved artist ever to work in the medium. His long association with Hugo Gernsback has made his work a virtual trade-mark of Gernsback Publications.



THE ACTUAL WAR

WORLD WAR II:

War That Had No End—1945-1950

Historians will have great difficulty in demarking the end of World War II, which began on September 1, 1939, and the actual beginning of World War III. Officially the military war between the Allied Powers and Hitler's Germany—the Third Reich—ended on May 8, 1945. The shooting war between the Western Powers and Japan came to a close on August 14, 1945, with Japan formally surrendering on U.S. Battleship Missouri on September 2, 1945.

Mainly due to Soviet machinations, obstructions, and chicanery, no peace treaties were ever signed with Germany, Austria, or Japan, by the Western Powers and Russia, their former ally.

1951—Soviet Machinations

The defection of Russia from the Western Powers, which began in 1945, steadily accelerated in tempo. The Berlin blockade by the Russians aimed to



Russia's Dr. Alexis Popoff



China's President Ming-Soong

expel the Western powers in 1948-49 was but a sample of what was to come. The celebrated American airlift, however, which supplied food and fuel to Western Berlin, completely upset Moscow's plan, and for the time being the Russians were check-mated—at least in their Berlin venture.

Supported, armed, and prodded on by Russia, the Chinese Red forces of General Mao-Tzé-Tung defeated the Nationalist armies. China, now in the grip of the Communists, signed a friendship and mutual assistance pact with Russia early in February 1950. General Chiang Kai-shek's Nationalist Chinese Government with several hundred thousand troops sought refuge on the formerly Japanese-held island of Formosa.

Encouraged by Communist China's success, Soviet Russia armed the Red North Koreans who promptly invaded the South Korean Republic in June 1950.

President Truman, however, upset the Kremlin scheme by invoking the U.N. and promptly throwing U.S. and U.N. forces into Korea. Forced into a small beachhead around Pusan by the Red forces, the U.N. armies turned an early defeat into a notable military victory, completely defeating the North Koreans who had been augmented by Red Chinese troops in 1951.

This setback deterred Russia but temporarily in their fanatical determination to Communize the world. Not strong enough as yet to engage into a full-scale war with the U.S. and the rest of the world, the men in the Kremlin continued to wage their Cold War, using their satellites whenever and wherever they could.

The Indo-China Communist campaign which had been gathering momentum for several years, burst into a full-fledged war early in 1954. Aided and abetted by Chinese troops—masquerading in Indo-Chinese Vietminh uniforms and using Russian arms—French Indo-China was overrun in 1954, in spite of U.N. help. U.S. and U.N. troops from Korea arrived too late, and there were not sufficient divisions available to turn the tide against the Reds.

Considerable numbers of U.N. forces had to be retained in Korea so that South Korea would not be overrun by the Chinese.

TRIPLE INVASION:

Siam, Burma and Malaya Overrun

While the Indo-China invasion was in full swing, Red China, egged on by the Soviets and supported by Russian arms on a prodigious scale, invaded Siam, Burma, and Malaya as well. By the end of 1954 the three states had been completely overrun, and henceforth took their orders from Moscow, through the usual Kremlin-dictated Communist setup.

One of China's and Russia's urgent reasons for possession of Siam, Malaya, and Burma was to hamper the U.S. in its future war effort. The U.S. produces only about 8 percent of the important metal, tungsten, but she uses one-fifth of the entire world's supply. China, Korea, Malaya, and Burma have 80 percent of the world's tungsten. Malaya was the chief source of U.S. tin supply. The U.S. consumes 40 percent of the world's tin supply and produces only 1 percent.

The United States and the other Western Powers did not view these aggressions with indifference, nor did the U.N. Nevertheless, Washington, London, and Paris knew full well that to fight the Communists on a dozen fronts would be suicidal. Moreover, China was not in the U.N. As in World War II, the U.S. realized that Europe was next on the Soviet time-table, and

proceeded accordingly to build up the armaments of Western Europe, so that when the Russians started rolling west, perhaps they could be stopped on the Rhine in a "holding" operation.

So, for the time being, strategy dictated that no intervention should be undertaken to liberate Indo-China, Malaya, Siam, or Burma.

With the advent of the Korean war in 1950 U. S. scientists threw themselves completely into war-defense work and, spurred by the armed Forces, in due time had come up with an astonishing array of war new machines and devices. But it would be several years before the blueprints could metamorphose into the finished product rolling from the assembly lines.

Thoroughly aroused by the end of 1954, the U.S. now began to rearm for an all-out total war on a scale that paled its 1941-1945 effort.

Early in 1954, Stalin, realizing that a showdown between Russia and the West was not too far distant, arranged for a conference between top U.N. representatives—but in particular U.S., British and Soviet Generals—in Berlin. After several weeks of feverish conference, the so-called *East-West Atom-Bomb Taboo Agreement* was signed by the various powers.

Bereft of its long, legal-diplomatic language the document simply meant that the signatory powers agreed not to use atomic bombs of any kind against each other. The agreement provided that the signatory powers also bound their allies from using atomic bombs for war use.

While cynics all over the world did not believe that the agreement was worth a single exploded atom, nevertheless, now, at the end of World War III, the astonishing truth remains that during the entire global war not one atomic bomb was used by any of the belligerent powers.

During the total war period while Russia was being punished more severely than the Nazis had ever been—when all her industrial plants were pulverized and gutted—why did she never use her stock of atom bombs? The answer lay in a single word: FEAR. Nothing else.

Postwar investigation reveals that at no time did the Russians ever have more than 100 A-bombs—they had not a single super-atom-bomb of which the U.S. alone had hundreds.

Moreover the Russian A-bombs were of the "simple" type, similar to the one used by the U.S. over Hiroshima in World War II. Russia knew our atomic bomb strength full well and was deathly afraid of retaliation, should she use an A-bomb first.

The Kremlin realized quite well that we had the potential not only to destroy completely *all* Russian big cities, but that in the process, tens of millions of Russians would be annihilated as well.

YEAR 1954:

The Yellow Peril—Red China Becomes War Power

By 1954 Red China under Mao-Tzé-Tung, aided by thousands of Soviet technicians, had become self-sufficient in war matériel of all types. Great modern war plants—many disguised as industrial factories—dotted the land, usually well removed from coastal areas. Many important strategical plants making airplanes, tanks, munitions, etc., were completely underground.

A five-year plan (1951-1956) to make Red China completely self-sufficient in foodstuff, textiles, and all other modern necessities was vigorously pushed by Mao-Tzé-Tung, giving the Chinese abundant promise that it would succeed.



Russia's former war lord Josef Stalin



China's former war lord Mao-Tzé-Tung



Chinese Invasion barges in their war against Japan

China, of 480 million—the most populous nation of the world—was coming of age. The white man's ancient bugaboo, the "Yellow Peril," would soon be a reality.

Korea, Once More. Early in 1954 Russia and Red China, dismayed and annoyed by the military stalemate in Korea, thought the time ripe for communizing all of Korea. Accordingly, 40 divisions equipped with the latest weapons and an abundant air force were thrown into battle-scarred Korea.

This time it worked for the Communists. By occupying almost overnight all Korean harbors by amphibious forces, the Reds made sure that their push would succeed. The puny, four U.N. divisions—the foreign, holding forces in Korea—were overwhelmed in two weeks and taken prisoners. Korea, too, was now completely Red from North to South.

Japan Campaign

Emboldened by their recent successes, the Chinese and Russians soon played their Asiatic trump card. The China Red leaders had never forgotten the Japanese invasion of China, while their Russian friends had never forgiven the unilateral U.S. occupation of Japan in 1945 and thereafter. By midyear 1954, their plans perfected, they struck.

For over a year Russia and China had processed some 12,000 lightweight, shallow landing barges. These were constructed with substantial wooden bottoms and with high steel sides to keep out ocean waves. Each barge was propelled with powerful diesel engines, and would carry 100 fully armed men. Other barges carried war matériel with 10 men each.

These barges, all well camouflaged, were anchored along the South Korean coast—only 100 miles away from Japan.

On a warm summer night with favorable tides, over 980,000 armed Chinese—all well trained and provisioned—crossed the Strait of Korea and landed on the beaches of the two nearest Japanese islands of Kyushu and Honshu.

While Japan had become aware of the imminent invasion several months before, neither she nor the U.S. had realized the magnitude of the threatened operation.

The six U.S. submarines and the three U.S. cruisers could not cope with the thousands and thousands of fast moving, extremely mobile barges. While 800 were sunk by the combined Japanese-U.S. effort,

most of the Chinese barges got through under cover of darkness. The Chinese landings were widely dispersed, too, making it almost impossible for the insufficiently armed Japanese forces to cope with the invader. The ensuing Japanese débâcle was complete—another Communistic success for the elated Kremlin.

It should be remembered that the U.S., though warned of a Russian or Chinese invasion as early as the beginning of the 1950 Korean aggression, frittered away valuable time. Nor did the U.S. sign its peace treaty with Japan till early in 1951.

Japan, her main war industries destroyed or made inactive during the 1945-1952 occupation, could not possibly have armed herself in two short years. By fall 1954 the U.S. had become fully aware of the Chinese-Russian danger and had begun to send war matériel to Japan—but again as in World War II, Western Europe had priority. Hence the U.S. effort once more proved far too little and far too late.

Thus when the full-fledged invasion came, Japan had too little of guns and ammunition. Rifles and hand arms in all classes were antiquated. Worst of all, she had less than one thousand warplanes, most of them outclassed by the Russian fast fighters and bombers manned by Chinese. Most of the Japanese planes that got off the ground were destroyed immediately. Those on the ground were bombed so thoroughly that the air war over Japan was finished in three days.

OKINAWA "PEARL HARBOR":

U.S. Nearly Loses Military Base

As will be recalled, the 1951 U.S.-Japanese treaty ceded Okinawa to the U.S. (Trusteeship). The U.S. therefore had little personnel or bases in Japan proper. But our Okinawa base was well staffed with men. We had a fair supply of war matériel and planes. Over a dozen submarines and an assortment of surface war vessels were stationed at the island.

On the morning of the Chinese invasion of Japan, on that historic August 6, 1954, Red China sent 300 large bombers from the Chinese mainland over Okinawa to "neutralize the American enemy base."

While our losses were not equal to those of Pearl Harbor, casualties were over 1,600 men dead or badly wounded. Nearly 300 planes were lost and 12 surface vessels sunk. Only about 50 large modern bombers were saved, principally because they were stored in man-made caves underground.

The enemy paid dearly for this new international outrage. Our alerted forces, particularly our fighter planes from the carrier *Lexington*, shot down 28 bombers which fell on Okinawa, 58 others were destroyed, falling into the ocean around Okinawa.

Many of the crew bailed out and were fished out of the ocean. *All pilots and co-pilots, navigators and bombardiers were Russians. So were 60 percent of the crews shot down over Okinawa. All bombers were Russian-made.*

Later it was ascertained that ALL planes operating over Japan on the day of invasion were Russian, with 50 to 60 percent Russian personnel.

The Soviets finally had given up all pretense of letting its duped satellites make war for them. They had come into the open—and were now frankly on their own.

R-Day Arrives. August 6, 1954, proved to be *R-Day* in earnest, for the day of the invasion of Japan also was the day when Berlin was seized after a hot and fierce but short battle. What had been known to all military men since 1945 came to pass. Berlin, a tiny island in a turbulent, vast Russian sea, was untenable for the Allied powers in the face of the overwhelming superiority of Soviet forces. It took only three days for the Reds to occupy Western Berlin.

Simultaneously, the Russians started to advance westward on the Elbe, encountering no serious resistance till they approached the formidable Rhine defenses thrown up in depth by the Western powers.

In the fall of 1954 the Allies had over two million men in the field, the Americans, French, and British continuously increasing their forces. U.N. legions from all over the world also kept increasing the European armed forces on a continuously accelerating rate.

The U.S., having known that Russia would strike sometime in the second half of 1954, was not too surprised at the Okinawa outrage. While temporarily stunned, Americans generally took the advent of total war with Russia in their stride. They gritted their teeth, settled down for a long war, and applauded Churchill's new dictum:

"More blood, more sweat, more tears toward final victory and world peace."

Most Americans welcomed the end of the nerve-racking Cold War—now they were sure what they were warring for.

The period 1950-1954 had been one of feverish activity in the U.S. New armaments, new arms, new electronic war achievements, new and improved personnel training had in that incredibly short period armed the country on a prodigious scale believed impossible only a few years ago. Undreamed of secret weapons and war machines had come forth in profusion.

But the high command had also a master plan. The whole strategy was based on the simple idea not to make war on the Russian people but only war on its rulers wherever that was possible. It had long been realized that the main body of the Russian population were not Communists, nor did they belong to the party. Consequently if the ruling party could be neutralized, the task of restoring world peace would be immeasurably easier.

As one five-star U.S. general put it: "*If you fight a huge octopus, aim for the head—never the tentacles.*"

The U.S. Super Weapons

Top priority was centered on two urgent needs:

1. Prevent enemy planes from bombing U.S. cities and war production centers.

2. Prevent Russian submarines from sinking our ships, or bombing our coastal cities, with atom or other bombs. As it was also known that the Reds had a number of super-schnörkel submarines capable of discharging small bomb-carrying planes, the danger from this source was acute. Remember, it was not known whether or not the Russians would use atom bombs. *Our defense forces throughout the war had to assume that they would.*

SUBMARINEGATOR:

The Advent of "Rasura"

Late in 1953, the U.S. Navy in collaboration with the British Navy had perfected the—*submarinegator*—RASURA—which became better known to the public under the popular name of—*Schnörkiller*. While neither navy has ever published the full technical details of the intricate device, the general *modus operandi* is as follows:

In the year 1919 an American, Dr. James Harris Rogers, demonstrated his newly invented underground system of radio communication. It was used extensively by the U.S. Navy at the Great Lakes Radio Station and in the U.S. Navy Radio Laboratory, Norfolk, Va. Later on the system was improved by Edward T. Jones for long-distance underwater radio.*

The U.S. Navy in 1918-19 used the underwater radio signaling system extensively. Surface signals were received over distances of 6,000 miles by submerged submarines. Actual transmissions between two submerged submarines were recorded over 3 miles.

In 1950-53 this basic idea for RAdio SUBmarine RAnging—RASURA—was carried forward to a brilliant success by British and American scientists. By means of special electronic equipment and using the newly invented *multiple-pulse frequencies*, it became possible to transmit radio waves of great intensity over long distances under water. These waves could not be detected above water, because the ocean's surface reflected them.

When these waves struck a submarine or the submerged part of a ship they were reflected back like radar waves. Specially devised instruments on the ranging ships which could be surface vessels or submarines—gave the distance of the submerged object. And its course could be automatically plotted in a few seconds. Best of all, the range at which submarines could be detected was over 2,000 miles. These particular waves bounce back only from metallic objects. Neither whales, schools of fish nor wooden ships reflect *Rasura* waves.

All Red Submarines Sunk

By the second year of World War III the British and U.S. Navies combined had sunk every one of the 550 Red submarines afloat that came into range, either by surface warships, or bombers, or in teams of both. Usually, destroyers, *Rasura* equipped, would get the sub's range, if it were too distant to hunt down, the destroyers alerted the nearest bomber base. Accurate fixes were radioed to the bomber, which then sowed a pattern of the new super-depth bombs around the sub. This was kept up until it was sunk. None ever got away, because the range was always known accurately.

As the Russians never captured one of our ranging ships, and as within less than 6 months the majority of the Soviet subs afloat—550, all told—had been sunk, they gave up their suicidal submarine war.

*See *Radio Amateur News*, July 1919, page 10; *Radio Amateur News*, December 1919, page 274. Also *The Electrical Experimenter*, March 1919, page 787.

Nor did they ever learn the true nature of *Rasura* for the duration of the war.

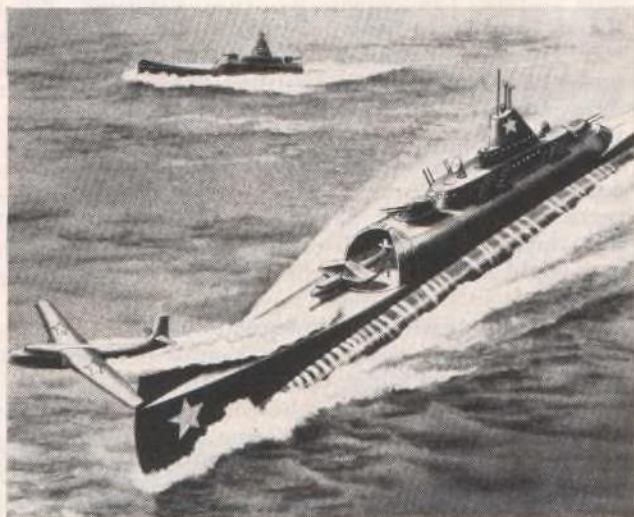
STRATORADAR:

New High Altitude Planes Boost Radar Range

Long before 1954 U.S. scientists had worked intensely on radar nets to protect our cities from enemy bombers. Unfortunately radar cannot reach beyond the horizon. Nor is it practical to erect very high towers reaching tens of thousands of feet upward. Even towers, like the Empire State Building, 1,200 feet high, reach only 50 miles as far as radar is concerned. Therefore enemy bombers flying at 500 miles per hour can be seen only 44 minutes before they reach the radar observation post. While the ordinary horizon radar range is about 50 miles from a 1,200-foot elevation, this "line-of-sight" distance (range) is extended to about 367 miles when the enemy bombers fly at an altitude of 50,000 feet above the earth. This gives the defenders insufficient time to take effective countermeasures.

It is true that on land—Canada cooperating with us—we could have built radar outposts in Northern Canada, so that the Russian bombers coming in from the north could be spotted further away, giving our fighters and interceptors more time to meet the invader. But such a scheme obviously is impossible on our eastern and western coasts.

For this reason the U.S. adopted the *stratoradar* system which gave us a greater time-alert period. And instead of having to build thousands of radar beacons in Canada and on our coasts and the Mexican border,

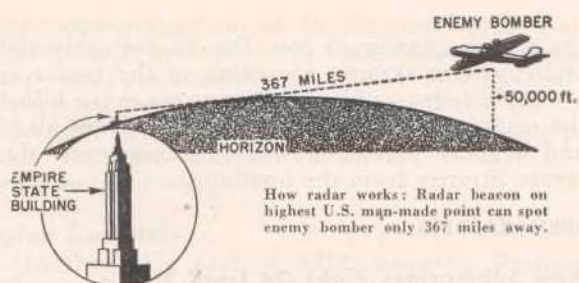


Russian Schnörkel sub with 4 bombers aboard.

less than 50 stratoradars gave superior protection throughout the war.

Stratoradar works as follows:

A large 4-jet plane—well-armed to protect itself in case of a raid—constantly flies in a small circle about one mile in diameter. Its course is radio-controlled from the ground by a special radio post. It flies either near one of our Canadian or Mexican frontiers, or over our east or west coasts. The stratoradar planes fly at fixed height of about 50,000 feet. The plane has special radar gear which makes a "sweep" over a predetermined arc. At the Canadian border this sweep is of course always northward. Irrespective of the plane's circling, the radar sweeps its assigned direction exactly, as if the plane were motionless. This is made possible by a special gyroscopic-directional gear, unaffected by the plane's motion in any direction whatever.



How radar works: Radar beacon on highest U.S. man-made point can spot enemy bomber only 367 miles away.



Stratoradar can spot enemy plane 670 miles away, giving us much longer time for alert.



By means of Stratoradar the U.S. Air Force intercepted enemy bombers coming from north 670 miles distant. By radio and land network all sections were then alerted. This gave us from 1½ to 2 hours to get ready after alert.

Stationed at a height of 50,000 feet the radar eye can now see over a distance of 670 miles. As enemy bombers must fly high, too, they are usually at a height of 40,000 to 50,000 feet. Flying lower is too risky because of anti-aircraft fire. Therefore, the radar can spot the enemy over 600 miles away. Flying at 400 miles an hour gives our fliers 1 hour and 41 minutes time to intercept them; at 500 miles an hour we have 1 hour and 21 minutes to meet the enemy—ample time for our fighter planes.

As each stratoradar plane scans a radius over 500 miles wide, we theoretically needed only 6 stratoradar planes to safeguard the Canadian border of 3,000 miles. For practical and operational reasons there was, however, a string of 15 such planes along the border, flying uninterruptedly day and night.

Canada for her own protection stationed a multiplicity of stratoradars far north and at both oceans as well, the two countries working together as a matter of course.

The stratoradar planes were relieved every 8 hours, each post therefore having a shift of 3 planes per day. There was one extra plane as a spare, and no planes were ever exposed on the ground. Underground bombproof hangars were provided for all grounded planes. All ascending alternate planes began their radar sweeps before the first plane began its descent. In this manner we had a completely uninterrupted and efficient radar defense net.

While no defense can ever be perfect on sea, on the ground, or in the air, nevertheless our stratoradar installations proved exceedingly effective. Of the 200-odd Soviet planes which broke through to Continental U.S. defenses, only 20—less than 10 percent—reached their targets in Pittsburgh, Detroit, Chicago, New York, and Washington.

The Russian super-demolition bombs inflicted the heaviest damage in Detroit, but even here the effect on the war effort was negligible. In the other cities

the damage was much less. Due to our early and effective alarm system, according to the best records available today—only 14,480 persons were killed by the combined Red bombings. This takes in all cities and includes persons who died subsequently due to severe injuries from the bombing.

SUBMARAUDERS:

New Submarines Fight On Land Too.

The U.S. in the early years of World War III had begun building a vast fleet of atomic-powered submarines, heavily armed with powerful 10-inch guns. They were fitted with the new highly effective super-schnörkels, which left practically no wake on the surface (see illustration, page 26).

Running several inches *below* the surface of the water, schnörkel "breathers" sucked in water as well as air by means of powerful pumps. Special devices separated the water from the air, dried the air and pumped it into the sub. The water sucked in was ejected below the surface.

These submarines were furthermore built with endless tracks similar to those of tanks, so they could rise from the ocean and run up landing beaches, then inland to raise havoc, destroy defenses, attack the enemy from the rear, and clear the beaches for our invasion troops. These huge monsters of the deep became known under the popular name of *submarauders*. The fearful war juggernauts fully justified their name in many campaigns all over the world.

Being completely atom-powered, they were thus not dependent upon gasoline or other fuels. They could run over 25,000 miles self-contained—a far greater distance than was ever required. They carried ample provisions for the large armed crew and a prodigious supply of various munitions. On account of their great land speed—over 60 miles an hour—they were not easily hit by the enemy—besides they were equipped with the miraculous—almost thinking—*electronic autoguns*. (See following.)

Smoke Enclouderers

Like our Navy destroyers they also used special chemical smoke *enclouderers*. If threatened by enemy artillery, the *submarauder* would eject a vast billowing cloud all around it, extending for several hundred yards in all directions. This made it an extremely difficult target. There were many other protective devices, such as radar, anti-radar, electronic micro-detectors to detect and blow up land mines, etc.

However, no *submarauders* were used against the enemy till all of the Russian submarines had been cleared completely from the seas. They were then used *en masse* as a surprise weapon, simultaneously in many theaters all over the world.

The Electronic Autogun

At the end of World War II and in the Korean Campaign the enemy frequently used specially muzzled guns and new smokeless powders, making it impossible for our gunners to see the gun flash. Seeing no target to hit nor any flash, our forces were often at a great disadvantage. Our gunners frequently could not discover the enemy guns to silence them with our own fire.

Long before this our scientists had been considering this phase, and many suggestions had been made to our Defense Department. The result was the development of an *electronic autogun*, popularly dubbed the *braingun*.

It is similar in some ways to the electronic AA

(anti-aircraft) gun which automatically tracks the enemy plane and despite any evasive turns or twists, hits its target. Such guns, radar equipped, find the enemy plane even if it hides in the clouds.

But a well-camouflaged gun is different. If it is partly hidden by a ground elevation or backed by a hill, radar is useless. Therefore the *braingun* must rely upon other detecting principles. The two chief ones are sound and beat. The *braingun* is equipped with highly sensitive ears, located in parabolic sound collectors. In front of the collector is an incredibly sensitive infra-red detector.

Now, infra-red radiation travels with the speed of light, whereas sound travels only with a speed of 1,100 feet per second. The *autogun* automatically moves the parabolic collector rapidly from side to side in the enemy direction. Should an enemy gun fire, the parabolic collector instantly detects it, due to the heat of the even invisible flash. The collector now freezes into a position which automatically gives the *autogun* the position of the enemy gun. It starts firing almost instantly at the target, destroying it.

Seconds later the sound waves of the enemy gun arrive and assist the *autogun* still further to get the final exact range of the enemy.

These *brainguns*, large and small, are highly effective. As finally evolved they do not require human hands to fire them—the "gunners" have become only ammunition suppliers or "shell-boys." All they do is load the *autoguns*—the *autoguns* do the rest. Many of the newer ones even load themselves from an elevated ammunition hopper.

Suppose the enemy too uses *autoguns*. What then? They did so in a few cases near the end of the war. There are a number of excellent counters to this, too, which our army used, although to this date our Army Department has refused to release any information on it. It is still classified.

When physicists first investigated ultrasound (supersonic—faster than sound) they were struck with a great variety of odd phenomena. It was discovered that these sounds which cannot be heard by human ears could kill many organisms as well as animals as large as frogs.

In the late 40's one investigator working with a powerful 800-cycle audio-sound unit became completely paralyzed while operating the machine. The paralysis was so great that he could not turn off the machine. Finally an assistant came to the rescue. The American technician—S. Young White—seemed none the worse for his experience.*

Since that time physicists busied themselves with ultrasound for war purposes. They finally succeeded in their efforts in 1953.

A team of two American scientists, Joseph Kane and Frank Sims, using a special supersonic "intermittent-pulsating" frequency at a power of 2 kilowatts, were able to put human beings into a cataleptic state similar to that normally occurring in deep hypnosis. Depending how long the subjects were exposed to these supersonic waves, they could be put into the deep cataleptic sleep for from one to six hours. During that time the body of the subject became as stiff as in rigor mortis. He could not move a muscle.

It was found that such supersonic catalepsy-inducing radiation could affect humans and animals over distances as far as 5 miles, provided suitable reflectors were used to train the waves in the appropriate direction. Usually the dosage of 30 minutes was sufficient to induce a 6-hour period of catalepsy in the distant subjects.

*See *Audio Engineering*, May, 1947, page 31.

The machine finally evolved for war purposes can be mounted on special trucks for fast mobility. It can be camouflaged perfectly and is usually used from prepared positions in the front lines facing the enemy. A number of these machines—dubbed *telehypsos*—are used in unison. The inaudible ultrasonic waves are now “sprayed” on the enemy who instantly becomes stiff and unconscious. There is no known counter for these waves except deep dugouts, thick concrete vaults, or caves which the ultrasonic waves cannot penetrate effectively. Even the crews inside of tanks were not immune, as the ultrasound easily finds its way through the crew’s breathing vents and other openings.

It should be noted that our operators *behind* the ultrasonic reflectors were not affected much; only those who were in the direct path of the concentrated beams were subject to the full effect.

During raids or assaults the *telehypo* radiating units were first switched on for 30 minutes, then turned off. Our forces then surged ahead toward their objectives, while subsequent waves took the unconscious enemy forces prisoner.

The *telehypo* was an effective surprise weapon. It proved singularly efficient in trench warfare and beach-landing operations. In the latter case the *telehypsos* were of course installed in our *submarauders*.

ATOMIC PLANE:

Poincaré Perfects Atomic Power

Atomic powered planes had been conjectured ever since the advent of the atom bomb in 1945. Every major airplane builder had toyed with the idea. The great problems always were how to protect the crew from the deadly radiations and how to employ the atomic power in the most effective manner.

The answer came when a group of American scientists succeeded in taming an atomic bomb explosion—slowing it down to perform useful work. This was tried long before the first atom bomb was exploded—in the well-known atomic pile. But such a pile is very inefficient and the heat generated is not sufficient to be *directly* used in jets for propulsion purposes.

It was always known that any one of the 94 elements* could be used for atomic energy once the key was found. More important, it had been known since 1941 that one of the most abundant elements on earth

*There are 102 known elements now, as of October 1, 1966.

—and consequently one of the cheapest—could yield, *proportionally* greater energy than uranium. (The actual amount per atom would be less.) That element is silicon—one-third sand. It was calculated that its nuclei could yield over 13 million electron volts per fission. But even today, the silicon nucleus has not yet been disintegrated.

Fission Complete

In the early part of 1952, however, Professor Alphonse C. Poincaré of Columbia University succeeded in bringing a number of other common elements to complete fission, i.e., split their nuclei. All of these elements were abundant and comparatively cheap. For security reasons the names of such elements have not been divulged to this date, nor may they be for some years to come.

We only know the five elements by the designations of F_1 (F for fission), F_2 , F_3 , F_4 , F_5 . Bombs far more powerful than the uranium types can be made with all F-elements—so can piles.

But Prof. Poincaré went much further. He showed how to regulate completely fission from a moderate heat of the unit to a point just below the titanic A-bomb explosion. This he accomplished by a special “moderator” which stops any destructive-explosive chain-reaction automatically.

Not only that, he invented the famous atomic-regeneration process, whereby all radiation is turned into harmless but useful electric current.

Since the advent of the atomic age, ushered in by the Curies, all atomic disintegration was accompanied by dangerous radiation. Yet all such radiation is *electromagnetic*.

Poincaré stopped all such dangerous rays by means of the famous *Poincaré power grid* which instantly turns any of all types of radiation into useful electric current, which can be used as power or heat.

When the Poincaré atomic power plant is installed in our huge planes the terrific heat blast let loose from the atomic disintegration is so powerful that the *granitite* jets glow white from the heat. The resulting thrust engendered by the atomic blast is of such great force that a plane can easily do 1,000 to 1,200 miles an hour at an altitude of 100,000 to 150,000 feet. The efficiency increases the higher it rises.

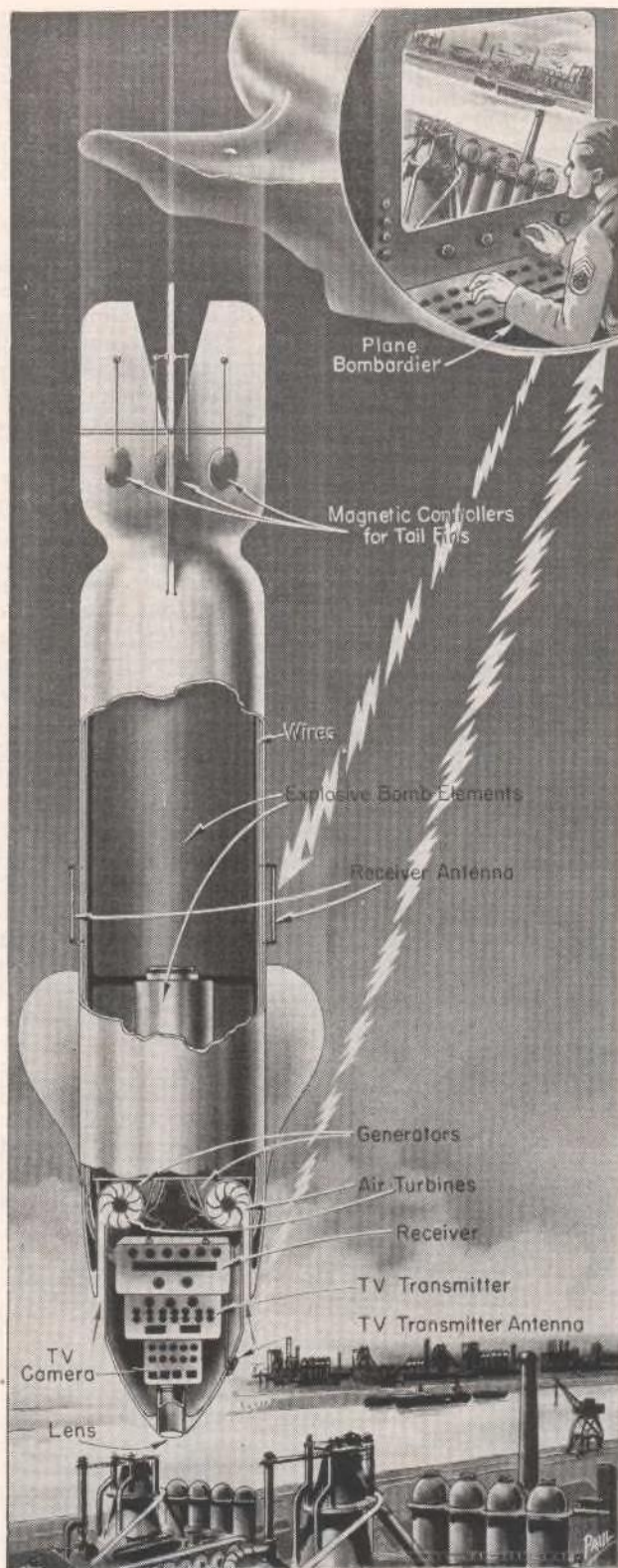
Coming off the production lines in quantity by the middle of 1954, the atom-plane proved to be our most potent single war machine.



The U.S. Electronic Autogun (Braingun)



Ultrasonic Telehypo



With the Television Bomb the bombardier can bomb the target far more accurately than is possible by any other known means.

Outdoing all other known planes in speed and power, it could stay in the air for days without alighting. No fighter plane could engage it at the great height it operated—25 to 30 miles up. No known anti-aircraft gun could shoot that high effectively. As the Poincaré atomic power plants use up but a few pounds of F_2 in a year's time, the plane theoretically could have stayed aloft for months at a time. But the early atom planes heated up too much and had to have their burned-out jets replaced frequently.

As neither the Russians nor the Chinese were able to match our atom-planes, the U.S. Air Force had things much their own way over all enemy country. This was so, particularly on account of the newly designed *television bombs*, which were coming off the production lines in the fall of 1954.

TELEVISION BOMB:

Bombardier "Sees" Distant Target

Up to the end of World War II bombing from great heights was a hit-or-miss proposition. Far too often only one or two out of ten bombs were really effective. The waste of bombs usually was appalling, particularly during overcast weather and when the bomber had to contend with attacks by fighter planes, anti-aircraft guns, etc. This situation was somewhat rectified toward the end of World War II when the *guided bombs* came into use.

Finally we evolved the *television bomb*, which put to an end most miss-hits and near-misses.

The television bomb is usually of the block-buster type—a huge thing often weighing 10 tons. At its nose it has a television camera operated by special batteries or by a small electric generator powered by an air turbine which is fed by the airstream as the bomb falls. The bomb has special fins and a tail, both of which can be moved to guide its fall. The steering is done from the bomber by radio remote control.

The television bomb thus is a regulation guided weapon, except that now the *television-bombardier* watches on his television screen the *exact* progress of the falling bomb. By radio control he can so manipulate the bomb's flight that it is easily guided to any building or target selected. No more fumbling and misdirected bombs. The bombardier can watch the bomb's progress through the thickest clouds, through rain and snow. Up to the instant of striking the target, the bomb's path is watched lucidly and clearly on the bomber's screen.

1954 Eventful

By 1954 the U.S.S.R. had chalked up a number of other successes. With the help of its satellites, Yugoslavia had been occupied while Tito and his Government had fled into exile in London.

An attempt to conquer Iran had only half succeeded, due to the foresight of the general staff of the United Nations. About half of Iran was in Red hands, half of it occupied by United Nations forces.

Denmark, too, was occupied in December of 1954. So was most of the Netherlands.

While the Russians made a number of attempts to cross the Rhine after their successful westward push in 1954, they never succeeded in this effort. Always cautious in their forward pushes, they calculated that time was on their side and that by a war of attrition they could finally push the combined United Nations forces into the Atlantic. The Kremlin believed their submarines would eventually sink all allied shipping, depriving the Western armies of all new manpower and war matériel. Then the final Russian push would defeat the United Nations armies in Europe.

Readers who followed World War III since its inception will remember that the Rhine fortification barrier ran from Rotterdam to the Swiss frontier with the Allied forces deployed in depth along the Western bank of the river.

Wisely, the Russians never attacked the Swiss. This powerful European redoubt stood up to Hitler and did so with Stalin. Anyway, the Russians did not feel like stirring up this powerfully armed hornet's

nest. Once the United Nations' armies were defeated, it would be ample time to look after the Swiss.

A similar train of logic was used with Italy and Greece. The Kremlin, as always, was playing a cagey and waiting game. "Why spread ourselves thin, like Hitler," was Stalin's argument, "when we will get them in the end, without firing a shot! On the other hand, all the countries we leave alone now will be grateful to us later and make our job that much easier after we have won the war."

The great hopes of the Kremlin—placed in their submarines—went for naught, however, as we have seen, due chiefly to American inventiveness and RASURA. By the end of 1954 all Russian submarines—schnörkel and nonschnörkel—were at the bottom of the seas.

In retrospect, let us digress for a moment.

Says one of the famed Russian writers Turgenev (1818-83) in his novel, *A House of Gentlefolk*, Chapter 33:

"Russia has fallen behind Europe. We must drive her on. It is said we are young—that's nonsense. Moreover, we have no inventiveness. Homakov (a character in the novel) himself admits that we haven't even invented mousetraps. Therefore, whether we will or not, we must borrow from others."

This Russian characteristic was well understood by the Western Powers ever since the advent of the atomic bomb. Henceforth they adapted the most stringent and extraordinary security measures in connection with all new war inventions, so much so that there were but few leaks. From that time on Russia was doomed—it was only a matter of time till our superior weapons produced *en masse* would annihilate her war-making power.

MAGENAPALM BOMBS:

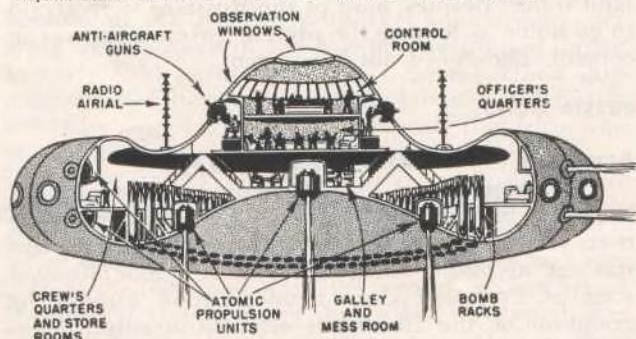
1955—Western Powers Ready

By 1955, all the great-producing Western Powers, the U.S., Canada, Great Britain, and France were ready for the final phase of the European-Russian war.

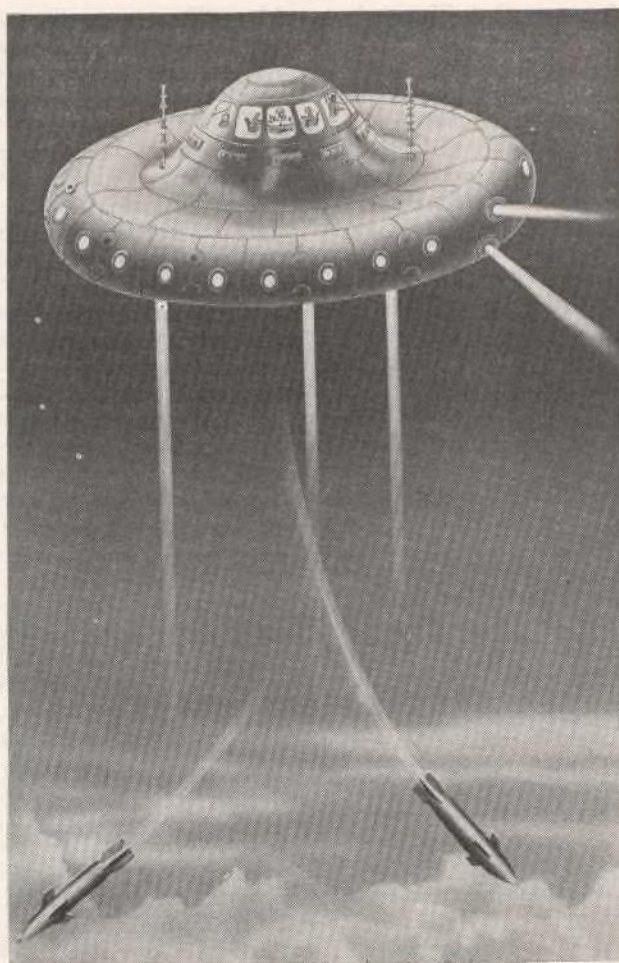
Immediately after the first bombing of U.S., Canadian, British, and French cities, American and British bombers retaliated on Russian cities with their newly developed *magenapalm* bombs. These bombs were not only terrifically effective blockbusters but the napalm-magnesium* combination was the most devastating fire spreader ever known. It should be realized that the first retaliatory bombing raids on Russian cities were made by our huge 4- and 6-motored bombers, *not* by our atomic-powered planes, which did not come into general use till later.

Russian Cities Bombed. Our bombers successfully bombed Moscow, Leningrad, Stalingrad, Kiev, Dniepropetrovsk, Odessa, and Sverdlovsk. We know now that these raids, which extended over 3 months, were

*Napalm bombs were used in the Korean war with excellent results.



Atomic Plane, powered by atomic energy makes 1200 miles per hour, rises 20 to 25 miles. Anti-aircraft fire, fighter planes, can't reach it.



Atom Plane dropping Television Bombs.

highly effective in slowing up much Russian war work. The known dead from these bombings amounted to 46,800. Permanently injured were 90,400. These are official Russian figures. No correct estimates on the material damage have been published so far.

Despite glowing newspaper accounts of that time, our air losses were much higher than published then. We lost 381 big bombers, with 3,072 officers and men; 2,041 parachuters were taken prisoner.

After these successful Allied raids, the Russians for a time made no serious further raids on U.N. cities, they evidently reasoned that if they did, the inevitable retaliatory U.N. raids would slow their war effort too much, and that it would be far better to build up their armaments till Russia became sufficiently powerful for the all-out push. But these careful calculations misfired, too, as later events proved.

U. N. STRATEGY:

Russians Get Big Surprise

During 1955 the contending enemy armies on both sides of the Rhine had each other checkmated. The Russians could not budge the Western Powers, nor could the latter drive back the Reds. Neither was really trying for an all-out struggle in 1955, for identical reasons—neither was sufficiently strong at that time. The Russians were still building up their manpower "to wage a successful war simultaneously in Europe, in the Near East, and in the Far East." The U.N., on the other hand, did not base their strategy so much on manpower as on a torrent of new weapons, mostly produced in the U.S.

By the summer of 1955 the U.N. High Command began bombarding Russian cities and soldiers on all

fronts with billions of pamphlets. These were floated down on June 20 from the first atom-planes to cross enemy lines. The operation was a complete success because no enemy plane or anti-aircraft gun could cope with our atom-planes.

The pamphlets—printed in Russian—set forth in simple language that the Western Powers had no designs on territorial Russia, that what the West desired least was to make war on the Russian people. The West's quarrel was only with Russia's misguided rulers who wanted to rule the world. This the U.N. Powers would never permit. Proofs of the Russian leaders' aggressions were then cited in an elaborate presentation with maps, figures, and dates. The message was signed by the heads of all the United Nations.

It is now known that the majority of the Russian people read these pamphlets, even though they destroyed or buried them promptly in fear and terror of the Russian secret police. But the very fact that the Allies were able to deliver the pamphlets, despite the "invincible" Russian air force, made a deep and lasting impression.

Ten days later a similar paper avalanche descended on the Russians. Now they were carefully informed that henceforth the Allied Powers would be complete masters of the skies. The population was warned that all further resistance would be useless, but that the Allies, true to their promise, would not wage war on the Russian people. The war would only be with their Russian masters and their war machine. The Russians were told that beginning on July 1, 1955, thousands of atom-planes would be over Russian cities ready to destroy all war-making plants of all kinds, annihilate all railroad communication centers, all bridges, all oil refineries, all steel plants, etc.

The Russians were informed that our new television bombs were highly accurate and that no cultural establishments, housing, etc., would be bombed (with certain exceptions where these were in the same blocks as the factories). The targets and their location were carefully listed and the people warned not to stay in the target area. This gave them 24 hours warning—sufficient to seek safety.

Atom Bombers Over Russia

Promptly on July 1, over 3,000 atom-planes appeared over several dozen Russian cities and other strategic military locations. Radio warnings from our planes were broadcast on Russian wavelengths, in the Russian language, that bombing would begin in 15 minutes. The date of July 1, 1955, will always be remembered by the Russians. On that day over 96,000 tons of high explosives, fire-bombs, and blockbusters were delivered with telling effect.

But what impressed the population most deeply was that only a few hundred people were killed in this, the greatest and most severe mass-bombing in history. And even these deaths could have been avoided. It appears that some of the higher placed authorities of several war plants did not take the Allied warnings seriously, hence they did not allow their workers to absent themselves. When the planes' radio warnings came, it was too late. In the rush to evacuate these few affected war plants, people were crushed and trampled to death in the ensuing panic. Very few people died, however, from actual bomb hits.

These mass bombings were repeated for several weeks till all targets were completely demolished.

The approaches of all known underground plants were so thoroughly destroyed with "earthquake" bombs that for weeks all the roads and approaches were completely impassable. All of the underground

plants were watched day and night by our observation atom-planes.

At night constant observation of all roads leading to and from the plants were made by infra-red light from our atom planes. Any traffic that appeared was bombed.

But all traffic leading out from Russia to the West was under especial scrutiny 24 hours every day for month after month. Over 2,000 atom-planes were assigned to this special duty. Stationed over 30 miles up, this great air armada could observe every single yard. No traffic to or from Russia escaped our atom planes.

This stratagem of course was complete attrition of the Russian armies stationed in Europe, and it succeeded brilliantly.

This time the Supreme Command of the U.N. forces did not repeat the mistakes of Napoleon and Hitler, by pursuing Russian forces into Russia, only to be bogged down in the wilderness. Our aim was to disarm the Russian armies in Europe, then occupy the main Russian centers and bring order into the country.

By August 1955 we had started making amphibious landings in force, east of the Rhine behind the Russian lines. We were greatly assisted in this by some 1700 submarauders which created such confusion among the Russian forces, stationed on the lower Rhine in Holland and as far south as Cologne, that over 800,000 prisoners were taken in a few days.

Our amphibious operations were supported by our atom-planes—which not only created complete havoc in the Russian air force by destroying all enemy planes as they landed—but which also, by means of special guided missiles, thoroughly disorganized the Russian land forces.

By this time the Russians and their allies who had been stationed near the Rhine were in full retreat. They regrouped, however, for a stand along the Elbe. This move was also short-lived. Remember, no supplies of any kind reached their lines from Russia, so they were forced to use whatever arms and matériel they had on hand and what food they could forage from the by now impoverished East Germans and Austrians.

Soon there was but little organized warfare, due to the effectiveness of the constantly increasing harassments by our submarauders and our completely unopposed Air Force, which decimated the remnants of the once powerful Russian Army.

Helped by U.N. pamphlet-and-leaflet snowstorms, which urged the Russian forces to give up and go home, this soon had a telling effect. The Russians by the end of November 1955 had surrendered by the millions. Altogether over 3,500,000 men were disarmed and taken prisoner. None could be repatriated that winter due to the stoppage of all railroads and other land traffic. Besides, most of the Russians were afraid to go home as long as the present government was in control. They need not have been.

RUSSIA QUILTS:

Armistice Signed with U.S.S.R. in 1956

In the winter of 1955-56 spontaneous revolutions broke out in nine large Russian cities. All communications were seized and a new provisional government was set up under a trusted and energetic Russian scientist, Professor Alexis Feodor Popoff, himself the grandson of the illustrious scientist-inventor, Alexander Stepanovich Popoff, of wireless detector fame.

Immediate steps were taken by the new Popoff

government to come to terms with the U.N. By that time 5 of the 15 Kremlin rulers had committed suicide. Stalin himself had died of a heart attack in February 1956. The other Kremlinites had fled to parts unknown along with a great number of Russian war criminals wanted by the Allies.

TERMS OF ARMISTICE

On March 1, 1956, an armistice was signed between the Russians and the United Nations.

The terms in short:

1. Total disarmament of Russia, with delivery of all arms, munitions, and atom bombs to the U.N.

2. Dismantling of all war plants, with the destruction of all tools, dies, and implements used in the manufacturing of war matériel.

3. Occupation by U.N. forces of 11 Russian strategic key points for a term of 50 years.

4. The institution of a democratic government elected by popular, secret vote.

5. Complete and free intercourse with the rest of the world without traveling restrictions in and out of Russia.

6. The U.N. undertook to protect Russia from other aggressor powers for a term of 50 years and agreed not to meddle in Russia's internal affairs.

7. A final peace treaty was to be signed between the U.N. and Russia in 1966, if by that time Russia had completed the payments of all reparations to the countries she had invaded.

Last week, on December 16, the peace treaty with Russia was finally signed at the U.N. headquarters in New York. Thus we are now, at long last, officially at peace with Russia.

The Russian people have come a long way since that memorable morning of August 6, 1954, the start of World War III, 12 long years ago. In the words of our President:

"Thanks to the brilliant leadership of Alexis Popoff, the new Russian Republic has prospered unbelievably since 1956. I know that my fellow Americans wish the Russian people well, too. May their peace be everlasting."

WAR WITH CHINA:

Atom-Bombers Finish China Reds In 1955

After the invasion and occupation of Japan by China in 1954, the U.S. Navy in collaboration with other U.N. countries, chiefly England and Australia, built up our Pacific outposts for a showdown with the Russian-Chinese aggressors.

It was a long and bloody uphill fight, chiefly on account of the Russian schnörkel submarines operating in full force in the Pacific and around Japan. In early 1954 particularly, the U.S. and Allied shipping suffered heavy losses. Our Atlantic and Pacific coastwise shipping was hit so seriously that for a time nearly all maritime traffic stopped.

Early in 1954 our Navies were fully *Rasura* equipped and within 8 months the last Russian submarine was dispatched to the bottom. But our own losses had been severe—over 39,000 officers and men both of the Navy and Maritime forces had been killed. Over 3,400 vessels, Navy and privately owned, had been sunk. The loss in money represented in ships and cargoes went to over 11 billion dollars.

From this point on, our strategy aimed first to

isolate completely Japan from the mainland so that the Russo-Chinese occupation army would be cut off from all future supplies. Our atom-powered submarine force by then had grown to large proportions and soon no surface sea traffic was moving through the Korea Strait or to the mainland.

Our submarines were mostly based in special concrete covered sea-coves on Okinawa and at our Philippine bases and other Pacific Islands as far East as Hawaii.

Throughout the years Okinawa had been fiercely contested and bombed almost daily. While our losses had been very high during the war, neither China nor Russia had ever been able to budge us from this, our furthest Western Pacific outpost.

Our submarines now began to systematically destroy all surface sea traffic around the China coast and in the Korean waters as well as along the Russian Siberian coast. By the end of 1954, not even fishing vessels were visible. *The pressure was on!*

This war of attrition continued up to 1955. Early that year, China, growing desperate in the attempt to keep its occupation army in Japan supplied with matériel, tried a number of new barge-expeditions through the Korea Strait. All of these failed—very few barges got past our submarine blockade.

By that time our Philippine-based air-jet armada had grown to such proportions that we began to win the air war over Japan and the surrounding waters.

Beginning of the End

But the beginning of the end of the Asiatic part of World War III came early in 1955, when our atom-planes finally went into action. These planes at first operated direct from our West Coast for security reasons. Flying at speeds as high as 1,200 miles an hour, the Pacific could be spanned in less than 6 hours with ease, reaching the most distant Chinese city an hour later. Or by flying the shorter, nearly all land route: U.S.-Alaska-Siberia-China, a distance only slightly over 6,000 miles, we could reach central China in 5 hours.

The same air strategy which we used so successfully in Russia came now into play. All Chinese Red cities were inundated with billions of leaflets setting forth the U.N. policy, that the Western and their Allied U.N. Powers had no quarrel with the Chinese people but only with those responsible for the war.

The population was told of the great power of our atom-planes which, 24 hours later, beginning July 1, 1955, would start bombing all Chinese military and strategic targets. The destruction began on the same day as its Russian counterpart and continued uninterruptedly for several months.

As our atom-planes used only television bombs, a relatively small number of Chinese were killed. This made a most favorable impression on the Chinese population, exactly as it did with the Russians. During August 1955, using a mass formation of submarauders and thousands of landing craft—which, with over a million U.N. troops, had been based on Luzon, Philippines—we occupied, mostly by surprise, the important Chinese coastal cities of Shanghai, Canton, Tientsin, and Peiping, and the Korean city Pusan. Hongkong, which had been wrested from the British by the Chinese in the summer of 1954, was also liberated by our forces.

Due to our complete mastery of the air and our great superiority of land weapons, our U.N. forces did not meet serious opposition anywhere, although the subsequent guerilla warfare proved extremely bothersome for many months.

Red China Quits in 1955. The principal units of Red Chinese armies had been cut to pieces by the end of 1955 and all organized warfare had ceased. The war with China had come to an end, chiefly because of the intense summer bombing of Chinese war plants. Russia had long ceased to supply China with supplies, so the Chinese war, steadily losing its momentum, ground to a halt.

Mao-Tzé-Tung and his associated generals and advisers fled to the Tibetan interior and were not apprehended till 1958. Mao-Tzé-Tung died by his own hand, as did a number of his followers. Others were brought back to Peiping where they stood trial. All were imprisoned.

Japan Liberated

Simultaneously with our amphibious landings at Chinese coast cities, we also threw a large force on the Japanese island of Honshu. This particular landing was effected successfully on the large Tokyo plain, key to Japan.

Here, unlike in Russia and in China, it was not necessary first to reduce Japanese strategic targets by bombing, because it was felt that the Japanese people would help us in disarming the Chinese and Russian occupation forces. This assumption proved correct. Cut off from the mainland for over one and a half years, the occupation forces did not have much heart left to put up a determined fight, except on the southern Japanese island of Kyushu. But we were now rapidly arming the Japanese and by late fall of 1955 all Russian and Chinese occupation forces had been made prisoners.

Outside of three weeks' fighting around Tokyo after the U.N. landings, all subsequent fighting on Japan proper was done by the Japanese. By January 1956, Japan was free once more.

Siberia Campaign

The third and final phase of the Pacific War took place in Eastern Siberia. As planned by the U.N. High

Command it was necessary not only to completely isolate the Russian Siberian armies, but to immobilize them too, so that they could not move.

This was accomplished entirely by a comparatively small atom-plane air force of 600 planes. As a first move, all war plants were completely destroyed. Next, all bridges and all marshalling railroad yards were totally pulverized. Now followed an around-the-clock bombardment of the right-of-way of the double-tracked Trans-Siberian railroad. First a 500-mile stretch of right-of-way was *melted* by high heat *magnothermite* bombs. This fused and melted the rails and made them completely useless. The operation was carried out between Krasnoyarsk and Ulan-Ude.

Another, the northern link of the Trans-Siberian railroad, was similarly reduced between Taishet and Kirensk. Simultaneously all visible rolling railroad stock from Novosibirsk to Vladivostok was destroyed by television bombing.

These operations completely bottled up the Siberian Russian forces, and made them useless as far as Russia was concerned till the armistice was signed between Russia and the U.N. on March, 1956.

The Chinese Terms

On August 10, 1956, an armistice was signed by provisional President Ming-Soong of the New Republic China and the U.N., paralleling in most instances its Russian prototype.

Chinese key points were to be occupied by U.N. forces for a term of 50 years to guarantee world peace.

A final peace treaty was to be entered into by China and the U.N. in 1966 if by that time China had fulfilled all her obligations and reparation payments to the countries she had invaded during the war, namely: Korea, Japan, Indo-China, British Hongkong, Siam, Malaya, Burma, and Tibet.

The Chinese peace treaty was signed last week, December 16, and World War III is now finally and officially over. +

Cost of World War III

The casualties of the belligerents, as far as it is possible to ascertain them today, on Christmas, 1966, are as follows:

- ▶ Dead: Between 2,750,000 and 3,000,000.
- ▶ Missing: Over 850,000.
- ▶ Seriously wounded: 4,250,000.

▶ These figures do *not* include the dead, the wounded, and the missing civilians, but they are probably much larger than the military figures. Nor do they include the dead due to starvation, nor the wrecked lives of countless other displaced persons numbering millions.

▶ Total cost: This can only be guessed at, but it probably runs over 9,875 billion dollars—that is, *our 1966 dollar, now worth about 10¼ cents of the World War II dollar.*

▶ The winner: *No nation.* All LOST World War III. If by good luck we can keep the peace for the next 100 years, our descendants by that time, in 2066, may have paid for that insane world's folly, begun in Sept. 1939.

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APRIL 1953

HUGO GERNSBACK, Editor

Science-Fiction **PLUS**

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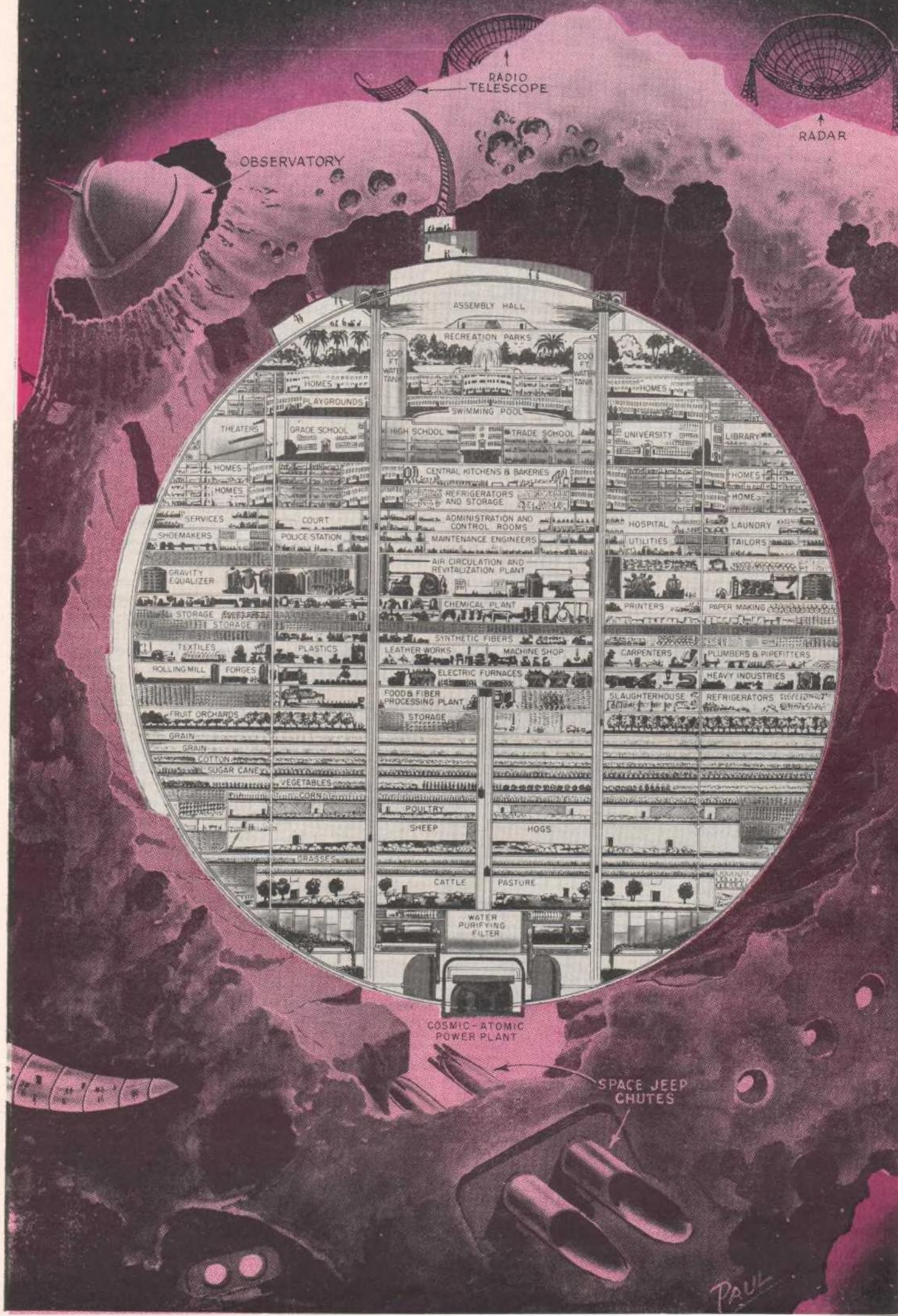


35¢

Thousand-Year Space Ark

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COSMIC-ATOMIC
POWER PLANT

SPACE JEEP
CHUTES

PAUL

INTERSTELLAR FLIGHT

SCIENCE

After man has explored the solar system, he will not be content until he has reached the stars. Time and distance conspire to thwart all but Methuselahs. Science-fiction has investigated various means of bridging the gap to the stars. Here Leslie R. Shepherd,

Ph.D., scientific advisor to The British Interplanetary Society, examines two of the most dramatic possibilities: first, of sending colonists on a 1,000-year voyage—a voyage whose end would be seen only by generations yet unborn; second, the utilization of the time-dilatation effect, where, at speeds near that of light, time would pass more slowly for the space voyager than for people back on earth. Dr. Shepherd supports his arguments with solid science and accepted theory. This is a revised and modified version of an article that appeared in The Journal of the British Interplanetary Society.

By **LESLIE R. SHEPHERD, Ph.D.**

(Illustrations by Frank R. Paul)



Leslie R. Shepherd, Ph.D.
Dr. Shepherd is the Technical Director of The British Interplanetary Society and an outstanding British authority on space travel.

Introduction

SOMETIME IN THE near future, perhaps before the turn of the century, man will take his first step into space. He will do so in all probability without being unduly concerned about the chain of events which he will be setting into motion. The significance of the act may not have escaped him entirely, but he is not likely to be influenced by considerations of the ultimate importance of interplanetary travel upon human affairs. Scientific curiosity and the love of adventure for its own sake will be sufficient motives for the first exploratory voyages.

Nevertheless there must be many apostles of space flight to whom these two motives are only a small proportion of the whole purpose. There must be many who cannot derive complete spiritual satisfaction from the picture of mankind spending its whole existence in one single infinitesimal planet with no contact with other species who may people countless other worlds of the universe. Many who hold to a more materialistic outlook may see in man's confinement to a single planet a factor reducing his probability of survival. Humanity dispersed over many worlds would appear more secure than humanity crowded on one single planet.

We are going to examine the possibilities of interstellar flight mainly from the latter viewpoint, viz., the possibilities of the human race establishing colonies in other stellar systems, always assuming that there are worlds suitable for mankind to be found in such systems. We are concerned with the problem of getting small colonies across the almost endless interstellar gulfs, safely, but ultimately, no matter how or in what time. It is not necessarily a question of getting an individual from one stellar system to another, but rather a question of getting an adequate community to another system. It is important to stress this point because this profoundly affects our interpretation of what is possible and what is impossible. For if we interpret the problem of instellar flight as the problem of transporting a man from one system to another during his lifetime, then it is a much more difficult problem.

The problem of interstellar flight is one of vast distances and interminable transits which may demand a completely new philosophy of exploration. If we accept the more general interpretation of interstellar travel then the explorer or colonist setting out for some distant system may do so in the knowledge, not only that he will never again see his native planet, but that he will not even see the planet of his destination—a privilege reserved for his descendants. Thus the philosophy of the explorer may be that of the soldier or airman setting out on a suicide raid, doing so in the knowledge that for him there can be no personal gain, only the dying knowledge that some will survive to benefit from his action. Indeed, interstellar colonization may call for the sacrifice of whole generations in the lonely reaches

of space. Colonies once established may have to exist for generations in a state of complete isolation, and such communication as may exist between systems may be a very tenuous and precarious matter.

Thus interstellar exploration and colonization may be vastly different from the exploration and colonization of our own world or even of our own system. It may require a revolution in our way of life not only socially but biologically if we are ever to become a galactic people.

Distance, Time, and Energy

We have already indicated that the dominating factor of interstellar flight is distance, vast unimaginable distance. When we discuss the achievement of space flight, of journeys to the Moon and our solar neighbours, we talk of velocities of the order of 6 miles per second. Such velocities are insignificant on the interstellar scale of magnitudes. A vehicle leaving our system for the binary Alpha-Centauri (at 4.3 light years distance,* our second nearest neighbor), would take about 130,000 years to reach that destination if it travelled at such a low velocity as 6 miles per second. Thus the statement that vehicles capable of achieving interplanetary flight could also fly to other stars, while it may be true, is nevertheless completely academic.

It is probably true to say that interstellar flight will be considered possible when transit times of 100 to 1,000 years can be realized, and not before then. In the case of a flight to Alpha-Centauri or other neighboring stars this involves mean velocities up to 6,000 miles per second. Let us see what such velocities imply in terms of known energy sources.

A rocket is propelled forward by the ejection from its rear of a stream of matter moving at a high velocity. The velocity attained by the rocket is proportional to the velocity of this stream or jet (the so-called exhaust velocity) and also depends upon the amount of matter ejected. A high exhaust velocity pays off a considerable bonus in rocket performance.

In the present-day chemical rocket, the exhaust velocity is determined by the available chemical energy of the propellants and the efficiency of the motor in converting this chemical energy into kinetic energy (the word "kinetic" means "matter in motion") of the gases ejected from the nozzle. The most favorable estimate of the exhaust velocity attainable with known chemical propellants, is about 2.5 miles per second.

Many nuclear reactions are millions of times more energetic than the most powerful chemical reactions. If nuclear fuels were employed in a manner analogous to chemical rocket propellants, i.e. if the energy of the nuclear reaction were concen-

* A "light year" is the distance light travels at 186,000 miles per second in one year's time.

trated entirely in the reaction products, then the exhaust velocities attained would be a thousand times, or more, greater than those attainable with chemical propellants.

It can be shown that so long as the mass of nuclear fuel carried by the rocket is less than four times the empty weight of the rocket, it would be better to dilute this fuel to such a degree that the mass ratio (the relationship of the mass of the fuel to the mass of the empty rocket) is made equal to 5. This procedure leads to the maximum rocket performance with the minimum fuel consumption.

Suppose that it was required to make a one-way transit to Alpha-Centauri—which is the nearest fixed star at about four light years distance—taking 250 years and using a fissionable material as our nuclear fuel. To do this in the most economical manner, we would need a mass of nuclear fuel equal to 2.4 times the mass of the empty rocket and sufficient inert propellant material to raise the mass ratio to the most efficient value. Under these conditions the exhaust velocity would be 3,780 miles per second and the rocket would be capable of accelerating to 6,000 miles per second, or alternatively (as would be required in this case) accelerating to 3,000 miles per second and braking down again to zero velocity. If it were possible to employ the lithium-hydrogen reaction, the same ratio of masses would lead to a transit time of 140 years in the voyage to Alpha-Centauri.

Since this necessitates a prodigious expenditure of what, in the fission case at least, would be valuable material, it is of interest to note that the exhaust velocity varies only as the square root of the proportion of nuclear fuel. In other words if a tenfold increase in transit time could be accepted, a hundredfold reduction in the proportion of nuclear fuel would be possible.

BEFORE PROCEEDING FURTHER, it is worth pausing to consider the nature of the propulsion unit which would raise the interstellar vehicle to the considerable velocities which we have been contemplating. Referring again to the example of a rocket going to Alpha-Centauri in 250 years transit time, we note that at the expense of increasing this to 350 years we could spend a 100 years in accelerating and decelerating. This corresponds to an acceleration of 60 miles per second for one year or about one three-thousandth of the acceleration due to gravity at the earth's surface. The useful power output of the propulsion system is proportional to this acceleration and also to the exhaust velocity (3,780 miles per second). In this example the power output would have to be 10 megawatts (the prefix "mega" represents one million) per ton of rocket (specific exhaust power); in other words, if the rocket weighed 10,000 tons, the power output would be 100,000 megawatts.

This represents a very severe power requirement and is certainly not one which could be met by present-day engineering technology. It is difficult to visualize engines running at such a high power level for 50 years continuously. However, it is to be expected that interplanetary flight techniques will have reached a very advanced state before man will be ready to embark upon deeper space flight, and low thrust/high exhaust velocity vehicles may have had several hundred years of development before called upon to play this exacting role.

The Ion-Rocket Principle

In all probability the vehicle which will carry our descendants on their first mission to the stars will use the *ion-rocket principle*, unless, of course, some entirely new method of propulsion is forthcoming by that time. In the ion rocket, the high-velocity exhaust jet is produced by accelerating electrically charged atoms (ions) in an electric field.

High velocities are attainable with accelerating voltages that are not outside the range commonly encountered today. Thus a velocity of 3,780 miles per second could be obtained with singly charged carbon atoms by means of an accelerating potential of 2,500,000 volts.

It is quite possible, in view of the high specific exhaust power required, that a great deal of the inert propellant carried by the interstellar vehicle would consist of power plant and propulsion unit replacements. From time to time during the acceleration program, the old worn-out (and probably burned-out) plant could be stripped out and consigned to the ion sources. As the voyage neared its termination and the all-up mass was reduced, the number of propulsion units might be reduced by a similar process. In this way nearly all of the initial

dead weight of the vehicle would serve some useful purpose in addition to its use as propellant.

The facts show that flight to the nearest stars appears to be possible in principle provided we are willing to accept transit times greater than 100 years, and possibly 1,000 years.

AT FIRST SIGHT the idea of advancing mankind's frontiers to points requiring hundreds or even thousands of years to reach, might seem hopeless. It cannot indeed be regarded as a particularly satisfactory picture of interstellar exploration. However, regarded in terms of geological eras, centuries or millennia are small intervals, and provided that human life can be sustained in exploring vehicles for long periods, there is no reason why interstellar expansion should not proceed on this basis.

An important factor in determining whether this state of affairs was adequate would be the frequency of occurrence of planets suitable for human habitation. Many theories of planetary origin suggest that only a comparatively infinitesimal proportion of the stars are blessed with planets. This being the case we might have to go much further afield than Alpha-Centauri to find alternative accommodation for mankind. However, no theory of the formation of planets, so far advanced, can be regarded as satisfactory and for all we know planets may be the rule rather than the exception.

Recent observations on the binary stars 61 Cygni (10.7 light years) and 70 Ophiuchi (12 light years) have indicated that nonluminous bodies of almost planetary dimensions are associated with both systems. If indeed two such close stars have planets it might well indicate that planetary systems are by no means rare phenomena and among the score or so stars which lie within about a dozen light years of our own Sun there may be many planets. One thing is certain, namely that an expensive expedition taking a small community on a thousand-year voyage to another star, would not start unless it was certain that the star possessed planets of more or less terrestrial characteristics. Thus the era of astral exploration must be preceded by a period of observational astronomy the like of which we could not contemplate today.

Instruments of performance vastly superior to those known at present would be required to survey the neighborhood of the nearest stars. The problem would be to resolve planetary images by perhaps no more than 0.5 second of arc, the planetary image having perhaps a strength of less than one billionth of the primary image. No telescope in existence today could give this performance or anything remotely approaching it, for although a moderate telescope of about 12 inches aperture could resolve two stars with this separation, the resolution of two fringe systems (the Airy Diffraction patterns, which represent the two images) when the central maximum of the one has an intensity of one billion times that of the other is quite a different matter.

However, the eventual construction of giant telescopes on the Moon or other comparatively airless bodies might make such observations possible. Even so, it might not prove possible to do any more than measure the orbits of planets detected in this manner, observe their spectra and obtain rough values of size on the basis of reflected light intensities. A more detailed survey might require an expedition to the system in question with provision for return unless the exploring party was provided with means of signalling its findings over the vast distance separating it from the home planets. This would be possible with existing radio techniques.

The 1,000-Year Voyage

The author is not competent to deal with the biological problems of life on an interstellar vehicle undertaking a voyage lasting for a millennium. Obviously they would assume a magnitude quite as great as the engineering problems involved. In the normal way, *some thirty generations would be born and would die upon the ship*. It would be as though the vessel had set out for its destination under the command of King Canute and arrived with President Truman in control. The original crew would be legendary figures in the minds of those who finally came to the new world. *Between them would lie the drama of perhaps ten thousand souls who had been born and had lived and died in an alien world without knowing a natural home.*

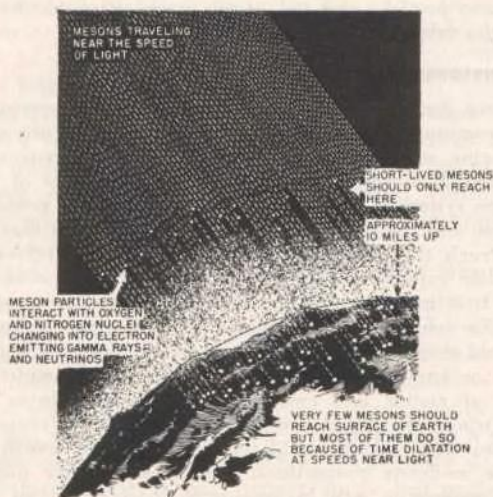
Perhaps this picture might change as a result of advances in medical science which are not yet visualized. It would be idle for a physicist to speculate upon possibilities which might

exist in this field and it is no purpose of mine to do so.

It is obvious that a vehicle carrying a colony of men to a new system should be a veritable Noah's Ark. Many other creatures beside man might be needed to colonize the other world. Similarly, a wide range of flora would need to be carried. A very careful control of population would be required, particularly in view of the large number of generations involved. This would apply alike to humankind and all creatures transported. Life would go on in the vehicle in a closed cycle; it would be a completely self-contained world. For this and many other obvious reasons the vehicle would assume huge proportions; it would, in fact, be a very small planetoid, weighing perhaps a million tons excluding the dead weight of propellants and fuel. Even this would be pitifully small, but clever design might make it a sufficiently varied world to make living bearable.

The passage of perhaps thirty generations would pose major problems of a sociological nature. The control of population would be only one of many. Children could only be born according to some prearranged plan, since overpopulation or underpopulation would be disastrous. The community would be subjected to a degree of discipline not maintained in any existing community. This isolated group would need to preserve its civilization, and hand on precious knowledge and culture from generation to generation and even add to the store of science and art, since stagnation would probably be the first step to degradation.

On the technical side one would list the conservation of habitability as one of the major undertakings. Maintaining a reasonable atmosphere over the long period of space flight would be no small matter. Loss of air from the vehicle, and of other volatile materials for that matter, could be very serious when integrated over a thousand years. A hundred milligrams of air leaking out of a million-ton vessel in one second sounds insignificant, but in 1,000 years it would amount to a loss of 3,000 tons of material. Artificial gravity would need to be provided by rotation, and one might visualize the vessel as a huge oblate spheroid. The list of problems could be increased endlessly, but they would all add up to the fact that an interstellar expedition under such circumstances would be formidable.



Flight at Near-Optic Velocity

Thus far we have confined our attention to a conception of interstellar flight based upon known principles, although involving considerable extrapolation from present technical capabilities. This has been characterized by a picture of voyages taking centuries or millennia to complete, entailing a strangely planetless existence for the travellers. This is not the notion of interstellar travel envisaged by many people to whom even the speed of light would be an irksome crawl. Since we are in no position to judge what sources of energy will be exploited in the remote future it is essential that we should investigate some of the features of flight at velocities approaching that of light itself.

It is an observed fact in our physical world that the speed of light in empty space is a constant and that no change in the motion of the Earth relative to other heavenly bodies results in any measurable change in this velocity. This fact led Lorentz, Fitzgerald, and others to formulate new equations of

motion, kindred to the theory of relativity by Einstein.

A consequence of these relativistic laws of dynamics which is usually regarded as setting a limitation upon flight to the stars is the limiting nature of the velocity of light. According to these laws a material body can never attain the velocity of light. The simple rules which govern the addition of velocities in the old Newtonian dynamics do not apply to very high velocities. To illustrate this let us consider a vehicle moving at a velocity of $0.9c$. It is convenient to measure very high velocities in terms of the velocity of light using c as the symbol for velocity of light; thus $0.9c$ means nine-tenths of the velocity of light. This velocity of $0.9c$ is the value measured by some observer at rest (with respect to the surrounding stars) who is watching the vehicle. Suppose that there is a super-gun on the vehicle capable of projecting a missile with a muzzle velocity of $0.1c$. If this gun is fired in the forward direction of the vehicle's motion, then according to the old Newtonian dynamics the observer should find that missile is moving with the velocity of light. But, according to the Einstein theory of relativity the observer will find that the velocity of the missile is $0.918c$.

Two further interesting facts are apparent from the relativistic theory. The first is, that an observer watching a vehicle which is moving relative to himself will find that the length of the vehicle appears to be reduced along the direction of motion. This effect is known as the Fitzgerald-contraction.

The second effect of importance is the time-dilatation. According to the theory of special relativity, the clocks on the moving vehicle will appear to the observer to be running slow. That is, the frequency of events which occur on the vehicle will appear to him to be reduced. In fact, the frequency of events appears to be reduced in exactly the same proportion as the length of the vehicle appears to be reduced in the direction of motion. We shall call this reduction the γ -ratio.

Thus an observer, watching a vehicle moving relative to himself at the velocity $0.990c$, will find that its length along the direction of motion appears to be only 0.142 of its length when at rest with respect to him, and the frequency of events which occur on the vehicle will appear to be only 0.142 or one-seventh of their normal rate.

The time-dilatation effect has been checked experimentally by observations of electrically charged particles called mesons passing through the Earth's atmosphere. These particles interact with the oxygen and nitrogen nuclei after entering the Earth's atmosphere and undergo a change, which resolves them into an electron emitting gamma rays and neutrinos. The height at which this change is made is known, as is the life of the meson. According to these factors and despite the fact that they may be traveling at the speed of light, only an immeasurably few mesons should ever reach the surface of the earth. In point of fact, a large proportion do reach the surface, a fact which can be explained only on the basis of the time-dilatation effect.

The slowing down of the tempo of events upon the moving vehicle relative to the tempo of the same events for the observer at rest, has an important bearing upon interstellar flight. If X is a traveler on an interstellar rocket which leaves the earth at near-optic velocity and returns with the same speed, then the time which he records for the voyage does not agree with that of an observer whom we shall call Y , and who remains on the home planet.

To take an example, suppose X goes from our system to Procyon (10.4 light years) and back with a velocity $0.990c$. The result is that, while the observer Y records X 's return 21 years later, X is aware only of a passage of 3 years. Indeed if X could get close enough to the speed of light he could circumnavigate the universe in his life-time, though he would find on returning that perhaps 10 billion years had elapsed and the solar system and stars that he knew had changed beyond recognition. This would in fact be one-way time travel.

Clearly, the attainment of velocities close to that of light would make interstellar travel a much more promising proposition than would the speeds which we have considered in the first part of this discussion. It would become possible for a man to leave his native system, journey to a star—even fairly distant ones would be within reach—and return within a few years of his time. The only shortcoming would be the fact that a long time would actually have elapsed at home during

his seemingly short voyage, and friends whom he left in the bloom of their youth would be found in their dotage. It is possible that human society, with the help of medical science, could adapt itself to such a state of affairs, but it is no purpose of mine to speculate on such matters here.

The first requirement of a vehicle designed to reach velocities close to that of light would be a source of energy far more potent than anything known today. The best that we could imagine in terms of our present-day knowledge would be the *wholesale conversion of mass into energy*. In modern nuclear and cosmic ray physics we know of a small number of processes whereby particles are completely converted into radiation, the oldest known process being the mutual annihilation of the electron and positron, with the complete conversion of their mass into electromagnetic energy in the form of two equally energetic photons. It is not known whether nucleons (i.e., protons and neutrons) can undergo similar processes; searches for the negative proton have so far proved fruitless. However, it is possible that such a particle can exist, if only for a short time, in which case the complete conversion of nuclear matter into energy is possible at least in principle. It would be quite pointless to speculate upon the possibilities of releasing energy in useful amounts by annihilation, since there is no process known to us today which might produce such an effect. However, it is interesting to investigate the behavior of a rocket making use of such powerful energy sources. In a conventional rocket, decrease of mass occurs by virtue of the fact that matter is ejected in the exhaust jet. On the other hand, in the super-rocket utilizing the wholesale conversion of matter into energy, mass is lost both through the expulsion of material in the jet and also the disappearance of matter which is converted into energy. If the full cycle of energy conversion is 100% efficient, however, it can be shown that the rocket behaves as though all the matter is expelled in the jet.

A case of particular interest is a rocket propelled by photons, i.e. by electromagnetic radiation. In such a rocket the available matter would be converted into radiation, which would then be directed into a beam leaving the tail of the rocket. This would be, in fact, a propulsive jet with an exhaust velocity c . The energy conversion would be 100% efficient, if all the radiation was beamed in the same direction.

A comparison of the classical and relativistic equations of motion shows that, while the latter places restrictions upon interstellar flight from the point of view of the stationary observer, it actually favors the traveler because of the time-dilatation effect. To illustrate this, let us consider a rocket with a mass ratio of 7.4, 100% efficient energy conversion, and a photon drive with exhaust velocity c . According to classic theory, such a rocket could attain a velocity $2c$, or alternatively accelerate up to a velocity c and then retard to zero. Thus on the classical theory, neglecting periods of acceleration and retardation, a rocket would reach Alpha-Centauri in 4.3 years.

In the relativistic theory, however, the actual velocity reached by the rocket will be $0.76c$, whence in the rest system the transit time would be 5.64 years. On the other hand the transit time in the traveler's frame of reference is only 3.67 years. Thus when we speak of the principles of relativistic mechanics being a barrier to interstellar flight, we are not being strictly correct. The most serious factor restricting journeys to the stars, indeed, is not likely to be the limitation on velocity but rather limitation on acceleration.

It is clear, therefore, that the limiting nature of the velocity of light is not necessarily the most serious barrier in the attainment of interstellar flight. In fact in most respects it is no barrier at all. The real difficulty, always assuming that we can find suitable energy sources for the job, lies in the unfavorable ratio of power dissipation to acceleration as soon as we become involved with high relative velocities. The problem is fundamental to any form of propulsion which involves nonconservative forces (e.g., the thrust of a rocket jet) to produce the necessary acceleration. The only method of acceleration conceivable that would not be subject to this difficulty would be that caused by an external field of force.

It might be argued of course that emitters at a temperature of $100,000^\circ$ Kelvin are not fundamentally impossible and that such temperatures are not even outside the range of our experiences today. However, the fact is that the utilization of radiators at this temperature is quite inconceivable in terms of existing techniques and we are therefore in no position to speculate profitably.

The Effect of Interstellar Matter

As soon as we consider motion through space at velocities comparable to that of light, we can no longer regard interstellar space as a complete vacuum. Interstellar matter is known to exist with an average density equivalent to about 1 hydrogen atom per cm^3 , though with variations of up to 1,000 between regions of lowest and highest densities. This matter occurs in two forms, (a) the interstellar gas, and (b) interstellar dust, it being probable that the latter accounts for approximately 1% of the total interstellar matter which consists mainly of gaseous hydrogen and helium.

M. W. Ovenden has examined the possibilities of collisions between an interstellar vehicle and the dust particles. He has found, on the basis of the available evidence, that the probability of collision is so low as to be no risk at all. We shall confine our attention to encounters between the vehicle and the interstellar gas.

At a speed of 8,400 miles per second a proton striking the vehicle would penetrate only a few microns into the hull of a ship. A small amount of radioactivity would be produced as a result of nuclear disintegrations caused by the bombardment, but this would be of no consequence. We see that a hull 1 cm thick of some material such as aluminum would be effective protection even at velocities up to 60,000 miles per second.

The problem becomes serious at velocities of 120,000 miles per second or more, when the oncoming particles represent a flux of "cosmic radiation" of great intensity. It would prove necessary to dispose a considerable mass of material in front of the living quarters of any vehicle traveling at near-optic velocities. This material could of course be used up in the closing stages of the retardation program when the velocity had been reduced to a safe level.

It is evident from the above considerations that the existence of interstellar matter could not be ignored in vehicles traveling near the speed of light. Precautions would have to be taken to ensure that the interstellar particles or any of the secondary radiations (mesons, etc.) produced by them could not penetrate to the living quarters, and that the heat produced from these particles did not result in excessive temperatures within the vehicle.

Conclusions

There does not appear to be any fundamental reason why human communities should not be transported to planets around neighboring stars, always assuming that such planets can be discovered. However, it may transpire that the time of transit from one system to another is so great that many generations must live and die in space, in order that a group may eventually reach the given destination. There is no reason why interstellar exploration should not proceed along such lines, though it is quite natural that we should hope for something better. To achieve a more satisfactory performance, however, we should need sources of energy far more powerful than any utilized or known today. Nothing less than the complete conversion of matter into energy would suffice to bring about speeds where the traveler could exploit the relativistic time-dilatation effect which would reduce interstellar transit times to quite moderate proportions. Even if we assume that such energy conversion will become possible it is by no means certain that we should be able to make effective use of it. A probable stumbling block in this direction is the extremely unfavorable ratio of power to acceleration which results from the use of exhaust velocities approaching the speed of light. It is quite impossible at the present time to come to any conclusion regarding the possibility of interstellar flight along these more ambitious lines.

The notion that the impossibility of velocities greater than c places any serious restriction upon interstellar communication is based upon a rather narrow outlook. It is true that if we think in terms of interstellar vacations, business trips to Capella and interstellar warfare, a certain inconvenience would be encountered. But these are minor features, and taking the broad view of things, the fact that it may take many years to go from one system to another is no great restriction. Indeed, so far as the traveler is concerned the limiting nature of the speed of light is more than offset by the time-dilatation effect; *from his viewpoint the speed of light is infinite*. And, though man can never travel faster than light, his frontiers will be limitless if he can approach it ever closer.

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AUGUST 1953

HUGO GERNSBACK, Editor

Science-fiction *plus*

preview of the future

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illustrated feature

THE END OF THE MOON

by

*Gustav Albrecht,
Ph. D.*

and Frank R. Paul

Complete Short Novel

SPACEBRED GENERATIONS

By Clifford D. Simak



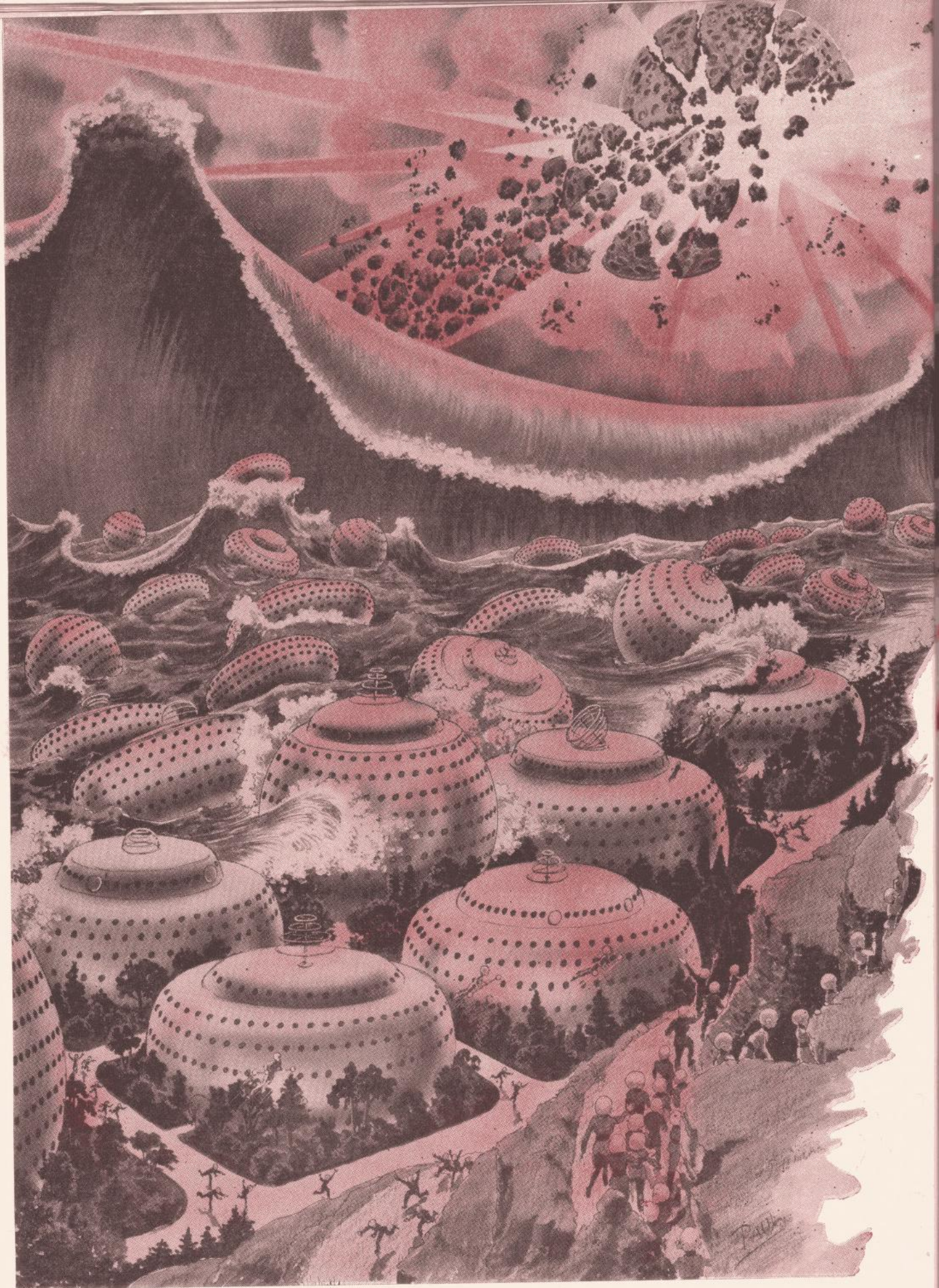
HANDS ACROSS SPACE

By Chad Oliver



Other Science-Fiction





As the moon, now only a few thousand miles away, is sheared apart by gravitational stresses, the waters of the Earth, which have been pulled into two great pools on opposite sides of the Earth, are released, and come thundering back toward the ocean and lake beds in tidal waves of tremendous height. Advanced man of this future period has constructed metal buildings that will float and not turn over, in an effort to survive the turmoil. Water-tight, doughnut-shaped buildings would be best for this purpose.



The end of the moon

by GUSTAV ALBRECHT, Ph.D., FRANK R. PAUL,
and DONALD H. MENZEL, Ph.D.

COVER ARTICLE

Frank R. Paul, renowned science and science-fiction illustrator, was given the assignment by SCIENCE-FICTION+ of depicting on the front and back covers the break-up of the moon. This was accomplished with the technical assistance of Donald H. Menzel, Ph.D. of Harvard College Observatory. Gustav Albrecht, Ph.D. was commissioned to ascertain scientifically when and how such an event was likely to occur and what the consequences would be. Everything in this article is based on sound scientific reasoning and not on surmise.

THE distance from the Earth to the moon has not always been the same, and it is still changing. Will the moon some day come crashing into the Earth? Or will we lose our moon to space? The ultimate fate of the moon is far more important to us than the fate of any distant star. If the moon should fall into the Earth we should certainly perish, and if we lose our moon we would also lose such phenomena as tides and eclipses.

Fortunately, science can answer these questions in surprising detail. The Earth-moon system presents one of the few problems of celestial mechanics for which our knowledge is sufficiently complete to give definite answers.¹

The moon is in fact receding from the Earth at about five inches per year, and will continue to recede for some billions of years, but at an ever decreasing rate. It will then return toward the Earth again.

We know from ancient eclipse records, from as

long ago as 40 centuries, that the length of our day is increasing. These ancient eclipses agree exactly as to the day with our calculations, but not as to the time of day, and they could not have occurred where they did, were the Earth not slowing down in its rotation. Calculations show that the increase in the length of the day amounts to 1/1,000 second per century. The reason for this is the tides, which are continuously pounding against the continents with an energy of 2,100 million horsepower, thus applying a braking force on the Earth. But how does this affect the moon? As the Earth slows down, the moon must move away from the Earth. This is a consequence of Newton's law of conservation of angular momentum,² and is confirmed by observations of the moon's shift among the fixed stars (5".8 per century observed as against 4".3 $\pm$.7 calculated), which agrees well with the evidence from ancient eclipses and the tidal braking of the Earth.

Before looking into the future, let us glance briefly

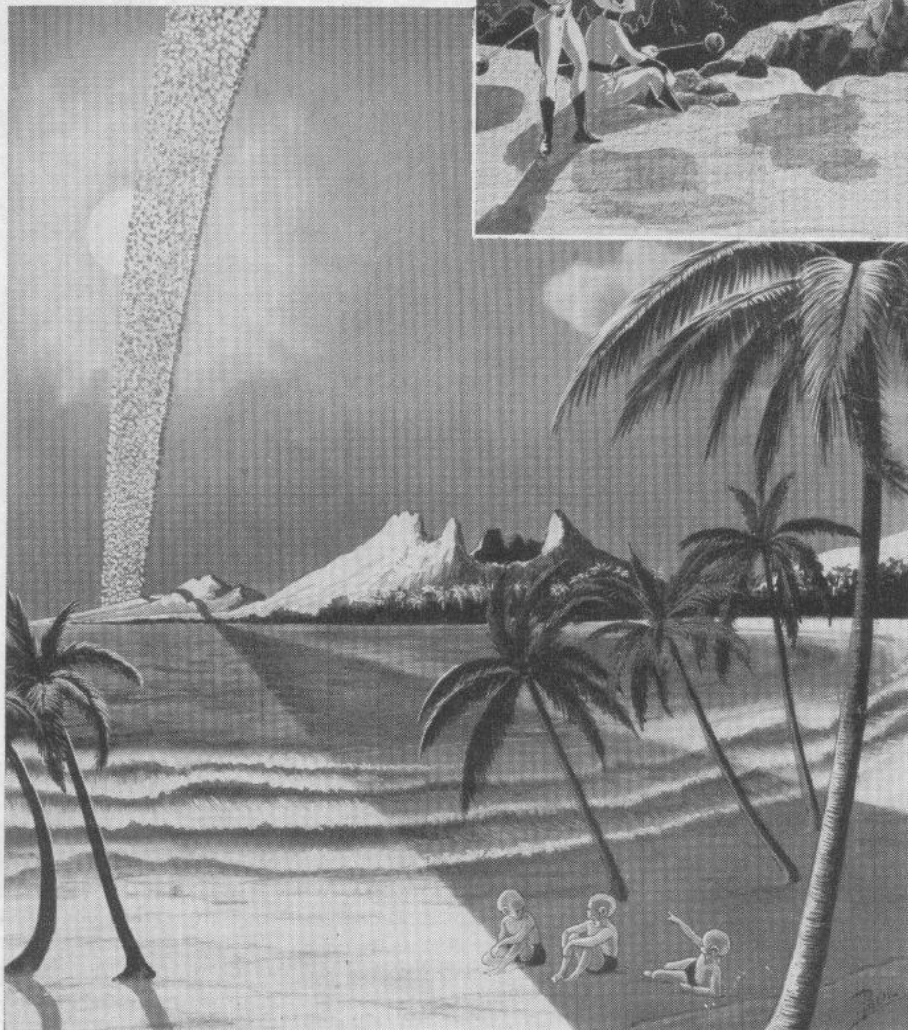
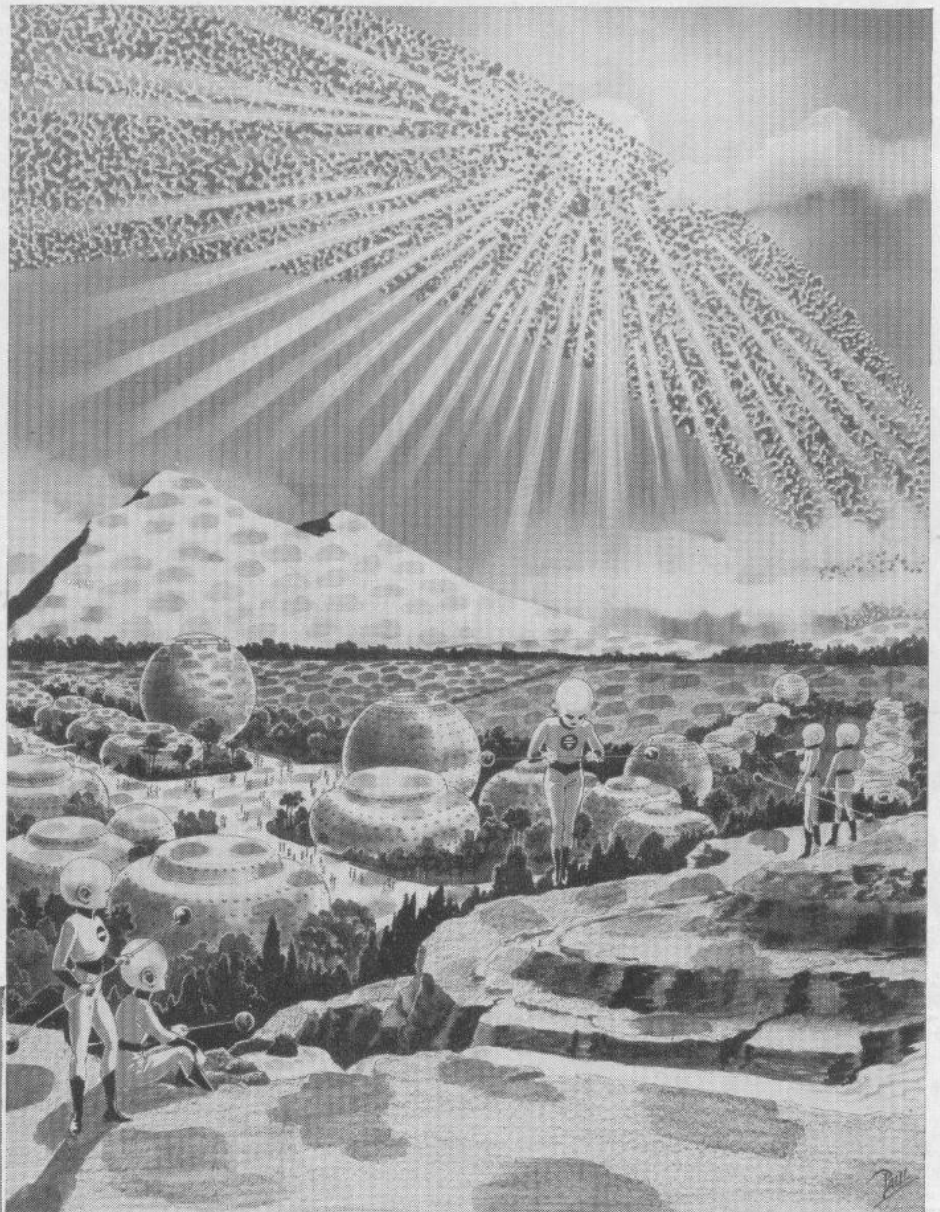
¹The classical calculations on the Earth-moon system were made by Sir George Darwin, son of the great biologist, and by Harold Jeffreys.

²See note on this law at end of article.

After the moon has broken up, its pieces will gravitate into an orbit around the Earth, forming a ring similar to that of Saturn. The humans who have survived the cataclysm will then rebuild their cities. Due to at least millions and possibly billions of years of development before this catastrophe, man will have evolved to a large headed, hairless state and probably attained a high degree of scientific advancement. Note, as the ring passes at the proper angle between the Earth and the sun, speckled shadow effects are cast on the landscape. These shadows would travel along the ground. Such a phenomenon would be especially common in the Earth's temperate zones.



At the equator, the ring around the Earth formed by the moon's fragments will display a narrower aspect—you see only the inside edge of the ring. When the sun strikes the ring, it will not throw shadows in blotches as in the temperate zones, but shadow will be solid. Wherever seen, the ring will present a glorious spectacle.



Gustav Albrecht, Ph.D.

Dr. Albrecht, although a member of the chemistry staff of Taft College is also an accomplished physicist. His figures were carefully checked at Mount Wilson Observatory, before release for publication.



Frank R. Paul

Although Frank R. Paul is a famed name in the science-fiction world, he is as well known as an architectural and mechanical draftsman, having designed the exterior of the famous Johnson & Johnson plant at New Brunswick, New Jersey.

Donald H. Menzel, Ph.D.
Dr. Menzel is the Acting Director of Harvard College Observatory. He was Assistant Astronomer, Lick Observatory; member Lick-Crocker Eclipse Expeditions, 1930, 1932; Director of Harvard-M.I.T. Eclipse Expedition 1936; three times winner of the A. Cressy Morrison Prize in science.





It has been suggested, by some scientists, that it might be possible to build rockets into the moon, and by the use of nuclear energy to drive it at a tangent to orbit, establishing a new orbit further out and staving off disaster for a great many milleniums. However, Dr. Menzel has calculated that a fabulous amount of energy would be needed to accomplish this feat, and that the chances were better that it might blow the moon apart, rather than push it out of its orbit. A desperate human race, might try it, and if the attempt were successful, the moon would be thrown into an elliptical orbit. A second blast at the furthest extremity of the ellipse would then be necessary to establish it in a circular orbit, so that the moon in process of completing an ellipse about the Earth would not return to the danger area from which it was propelled. Such an achievement, remains at best, highly conjectural at present.

into the past. If the moon is receding from the Earth it must once have been much closer than it is now.

Indeed, extrapolating into the past we find that it must have been nearly in contact with the Earth some 2 or 3 billion years ago. This figure is suggestive because it agrees roughly with independent calculations of the age of the Earth and the universe. However, the moon probably did not come from the Earth, but had a separate origin more than 10,000 miles from the Earth.³

At that time the day was little more than 5 hours long, and the month but a little more. Both moon and Earth were then inclined at perhaps only 12° to the Earth's orbit. When the moon in the course of time got to $\frac{1}{3}$ its present distance from the Earth, it solidified. Then its tidal bulge formed into what Jeffreys has called a "fossil tide" which is now responsible for the moon's keeping the same side toward the Earth.

The moon continued to recede from the Earth, until now, as everyone knows, we have a 24-hour day and a 27-day month. But as the moon continues to move away at 5 inches per year, the month will increase by $\frac{1}{8}$ second per century until the day and

³Gamow, in his recent book, *The Creation of the Universe*, believes the moon came from the present site of the Pacific Ocean, but Jeffreys and Harold Urey, to mention only two, disagree. It is interesting to note that two authorities in the field, Gamow and Urey, writing within the past year, disagree on this point.

the month become equal to 47 of our present days. This will require some billions of years.

Until now we have neglected a factor that will assume paramount importance in the destiny of the Earth-moon system, namely the sun, which also causes tides. To this point in our discussion the solar tidal effect has worked with the moon to slow down the Earth. As the solar braking effect continues, the length of the day will be still further increased, until the day will become longer than the month!¹ The moon's tidal effect will tend to accelerate the Earth's rotation, and by the same law of conservation of angular momentum, will cause the moon to gradually return toward the Earth. This phenomenon will continue until the moon approaches the Earth so closely (a few thousand miles) that the Earth's tidal pull on the moon will break our satellite into pieces. (This is Roche's law which states that for a liquid satellite of the same density as its planet, the tidal force will break it when the satellite reaches a distance of 2.44 times the radius of the planet.)

This fragmentation of the moon will without doubt be the most dramatic part of the moon's long history. The long journey away from the Earth and back again through eons of time will be so slow as to be imperceptible in any generation of man (except perhaps to the generation of astronomers when total solar eclipses become impossible—and the later generation, on the moon's return trip, when they become possible again). But the final crackup of the moon will be a sudden and awe-inspiring event. Let us now imagine the conditions on the Earth before and after this catastrophe.

As the moon approaches the Earth through billions of years the tides will become gradually more severe. The present-day tides of a few feet will increase to hundreds of feet, and finally to miles—drawing the waters of the Earth into two great pools on opposite sides of the Earth in equatorial regions, but will leave the arctic and antarctic regions drained, and perhaps habitable.² Severe earthquakes will possibly be a constant occurrence. Perhaps mountains of great height will have formed, and may be habitable as islands. Certainly the Earth's continental outlines will be much different than they are now. As recently as the Cretaceous period, less than 100 million years ago, more than half of North America was under seas, so we could hardly expect the continents to be exactly the same even by ordinary geologic processes, in the course of billions of years.

The breakup of the moon into many small fragments occurs because of the difference between gravitational forces on the near and far sides of the moon. When the moon has returned close to the Earth where it again swings around in 5 hours, the far side of the moon "wants" to revolve in an orbit that takes about 9 percent or about 50 miles longer than the time required for the moon's center. Analogously, the near side of the moon "wants" to revolve faster than the center by about the same amount. As a result, the moon is subject to a shearing force along its orbit, a force that tends to stretch it

¹As to the solar braking action, the Earth will slow down still further until finally it keeps one face turned toward the sun. Then the Earth will start to spin backward, rotating from east to west (clockwise). The sun, the moon, and the stars will rise in the west and set in the east. During this phase, the tides will tend to speed up the Earth's rotation and the moon, conserving angular momentum as before, will draw in toward the Earth, a process that will continue until the moon comes within a few thousand miles of the Earth's surface. Then the Earth's tidal pull will disintegrate the moon.

²Within a few hours after fragmentation starts, the giant tides will begin to subside. Within a few days the moon fragments will be so spread out over its orbit that no major tidal effect will occur except in the equatorial plane. The rings will still draw water away from the poles, leaving them free from oceans of any great depth. The equatorial regions will be covered with water more deeply than now, but the high lands will still stand out.

into an egg-shaped form. Finally, the gravitational shear between near and far sides becomes so great that the moon will split up, breaking into many fragments. Within a few days after the breakup, the jagged rocks that once formed the moon will have been spread out along the orbit—forming a sort of ring surrounding the Earth.

Very few of the rocky fragments will fall in toward the Earth. Most of them will swing in roughly circular paths about the center of the Earth, occasionally colliding with one another, causing further fragmentation until a narrow ring results, closely resembling that surrounding the planet Saturn.

Gradually, as this uniform ring is formed, the great tides on Earth will subside and almost disappear—and the oceans will again occupy the basins of the Earth. The tides from the sun will continue, but the days of the "great tides" will be past. The ring stage of the Earth-moon system should make for a placid time, with diffuse, almost shadowless moonlight every night and peculiar eclipses of the sun when the sun crosses the ring in the sky, partially eclipsing it, but reflecting brightly from the rest of the ring.

During this discussion it has been tacitly assumed that other things will remain as they are today. Considering that the time involved may be a billion or more years, this assumption is clearly not valid. For one thing, our sun is aging, too. Through the billions of years it may cool off considerably. As the Earth receives less and less energy from the sun, its climate will become constantly cooler. Also the sun will become more dim and the oceans of the Earth will freeze. Just when this will occur is uncertain, but when it does, ocean tides will cease and only the relatively small and almost frictionless atmospheric tides will remain to slow down the Earth—greatly retarding the moon's career as outlined above.

Let us also consider man as a factor in the picture. If within a short million years man could become absolute master over the plants and animals of the world, could he not in a billion years become master of his planet's destiny?

Advances in biochemistry will doubtless make man the master of his body, so that he can control its evolution to hardier forms, and prolong life indefinitely.

And if the oceans freeze—by that time the experience of many ice ages—such as have repeatedly occurred in the recent past—will doubtless teach us how to cope with cold, perhaps by tapping the inner heat of the Earth itself closer to the dimming sun. Or, as an alternative, could we not move to another planet or artificial satellite when the moon was ready to break up, and return to the Earth later?

I would hesitate to put any limit on man's ability to manipulate his physical environment billions of years hence. However, if the sun, in the course of the ages, should turn into a nova and explode, then mankind will certainly be utterly destroyed within minutes of the celestial atomic explosion—unless the astronomers of that age had calculated the sun's end and led the Earth's population to security on another solar system.

Note on the law of conservation of angular momentum.

The law of conservation of angular momentum, so important in the above discussion of the Earth-moon system, is also of great importance in earthly affairs. Cyclones, trade winds, and ocean currents are largely determined by the effect of this law, and it must be taken into account when firing large shells north or south. Most people go through life never aware of this law, and still it is possible to observe the effect by a simple experiment as follows.

Holding some heavy object in each hand, and with arms extended fully, spin on the sole of one foot on a smooth floor. While spinning, quickly pull the hands in toward the body. Your rate of spin will increase markedly, and you will probably lose your balance, but by rapidly extending your hands again you will slow down.

The law of conservation of angular momentum states that $mvr^2 = \text{a constant amount for a frictionless system}$. When you pulled in your arms you decreased "r." To keep the product mvr^2 constant it was necessary for "v," the rate of rotation, to increase. The mass "m" remains constant, of course. Dancers utilize this principle in making pirouettes.



Within a few days after the moon breaks up, the pieces will have been spread out along its former orbit—forming a sort of ring *surrounding* the Earth.

Very few of the rocky fragments will fall in toward the Earth. Most of them will swing in roughly circular paths about the center of the Earth, occasionally colliding with one another, causing further fragmentation until a narrow ring results, closely resembling that surrounding the planet Saturn.

The ring stage of the Earth-moon system makes for diffuse, almost shadowless moonlight—actually “ringlight”—every night, and peculiar, partial eclipses of the sun when the sun crosses the ring in the sky, but reflecting brightly from the rest of the ring. See *The End of the Moon* in this issue.



PAUL & Tina

THE SPIRIT OF SCIENCE-FICTION



PAUL
&
Jima

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